A NOVEL OPTIMIZED & ENERGY EFFICIENT HYBRID PSO ALGORITHM FOR EMISSION CONSTRAINED ECONOMIC LOAD DISPATCH

Himanshu Anand[1], Pratik Kumar Kar[2]

[1,2]*Department of Electrical Engineering, Marwadi Education Foundation Group of Institution, (India)*

ABSTRACT

The emission constrained economic load dispatch (ECELD) is a optimization problem to minimize expenses while fulfilling the power demand with including emission constraint. A key challenge for the coal-fired power plant generation loading is to abate fuel consumption and to control emission within the environmental limit. In concern environmental awareness, electrical utilities are required to reduce their emission level well below defined standards. The ECELD dispatch problem can be solved by several control algorithms. But in this paper we have proposed a new control hybrid PSO algorithm known as hybrid constriction particle swarm optimization (HCPSO) which increases the exploitation and exploration of search area more effectively. The analysis on this improved PSO is presented in this paper.

Keywords: Constriction particle swarm optimization (CPSO), Economic load dispatch (ELD), Emission constrained economic load dispatch (ECELD), Hybrid constriction particle swarm optimization (HCPSO), Particle swarm optimization (PSO)

I. INTRODUCTION

All the conventional electrical power plants employs different fossil fuel as source of energy to produce electricity and emission byproducts. The resultant emitted gaseous byproducts released to the atmosphere. Main concern out of those gases is due to the greenhouse gases like no, so_x , co_2which have tremendous impact on environment. Thus it is required to generate electricity at least possible cost as well as at minimum level of pollution. The emission constrained economic load dispatch (ECELD) problem is defined so as to reduce the operating cost with emission as constrained [1]. In concern environmental consciousness, electrical utilities are required to decrease their emission level well below the standard level [2].

We can limit level of emission by including the emission as constraint in the calculation of cost per unit generation. That's why ELD problem not only deals with minimizing the cost ensuring all constraints but at the same time it also limit the emission value [3]. The conventional ELD problem deals with the allocation of power in such a way so as to carry out generation economically with all constraints ensured [4]. But due to the continues increase in the load demand the amount fuel consumption in the power plant is also increasing respectively. Ultimately it follows an increase in total emission of gaseous pollutants from the consumption of fossil fuels. So far the only criterion of economic load dispatch is to dispatch electric power economically only and now minimization while considered emission as constraint is also important for all generation utilities [5]. But ideal generation dispatch deal with minimizing the total generation cost of system. Therefore, the overall system not only depends on the economy and relative cost of production which ensure cheapest production by adopting most convenient schemes.

There are several methods that can be implemented to solve the ECELD problem. Several Classical methods used for this purpose. But their outcome totally dependent on the parameter selection i.e. the step size. Due to this problem it can drives the whole system to oscillations for any inappropriate value of step size. That's why all such mathematical programming based algorithms such as Newton- rapson method, lambda iterative method, Lagrange relaxation, gradient based method etc does not prove to be applicable for non-linear or non-convex cost functions [6]. Also these methods involve a derivative approach which does not converges and constraint handling cannot be successfully met. The problem of constraint handling can be overcame by dynamic programming (DP) approach [7]. But DP approach can't be used in case of highly dimensional problems since it fails to converge in such problems. Thus, these classical methods does not provide solution in large scale optimization problem.

We can also optimize ECELD problems by stochastic searching algorithms such as genetic algorithm (GA)[7], particle swarm optimization (PSO), simulated annealing, artificial immune system (AIS), evolutionary programming (EP), memetic algorithm, krill herd algorithm, functional optimization, clonal algorithm, adaptive hopfield neural networks, neural approach. Compared to different classical methods of problem solving technique these methods provides better result due to their tendency to explore new solution with appropriate satisfaction of constraints and hence provides more flexible and efficient results.

PSO approach uses a random selection approach while preserving the overall population and search for better solution [8]. It has faster convergence rate and balance between the local and global search [9]. But the main problem with this approach is that if it get trapped at a particular solution i.e premature convergences. Also the velocity of particle is oscillatory in nature thts why some times it may not be able provide any stable solution [10].

The convergence towards a stable solution is one of the most important property of any good searching algorithm. In 1999, constriction factor is introduced by Clerc [11]. Constriction particle swarm optimization (CPSO) is the powerful searching technique that uses constriction factor of evolutionary programming and provide an efficient and fast solution to the optimization problem. But exact balancing of the parameters in CPSO is required for obtaining the desired results [12] or else it may suffer less exploring at the beginning of searching and sometime unable to find a appropriate solution. To overcome the various limitations to find optimum solution by PSO and CPSO we are using HCPSO which is having advantages of both PSO and CPSO.

II. FORMULATION OF ECELD METHODOLOGY

We have considered both problem of cost optimization and emission problem as constraint for formulating ECELD problem. We have formulated by considering both equality and inequality constraints.

2.1 Objective Function

Cost Function: The cost function of each thermal generator, with the valve-point effect is represented as the sum of sine and quadratic function. The fuel cost in terms of generation output can be expressed as:

$$CF = \sum_{i=1}^{U} (a_i G_i^2 + b_i G_i + |d_i \sin\{e_i (G_i^{min} - G_i)\}|) \quad (1)$$

where a_i, b_i, c_i, d_i, e_i are the cost coefficients, CF = Fuel cost function of power units, G_i = Real power generated of ith unit. , G_i^{min}= Minimum power of ith unit, U = Total number of power unit.

2.2 Emission Function

Emission (ton/h) of pollutants is the sum of an exponential and quadratic function can be expressed as:

$$EF = \sum_{i=1}^{U}(\alpha_i G_i^2 + \beta_i G_i + \gamma_i + \eta_i \exp(\delta_i G_i)) \quad (2)$$

where $\alpha_i, \beta_i, \gamma_i, \eta_i, \delta_i$ are the cost coefficients. EF = Amount of emission released by thermal unit.

2.3 Constraints

In power system, the ECELD is subjected to many constraints. There are two types of constraints in ECELD.

2.3.1 Equality Constraints

The total power generation from thermal units must meet the load demand and the transmission losses in the transmission lines.

$$\sum_{i=1}^{U} G_i = G_D + G_L \quad (3)$$

where G_D is the power demand, G_L is the transmission losses, which are approximated in terms of B-coefficient also called as Kron's loss formula:

$$G_L = B_{00} + \sum_{i=1}^{U}\sum_{j=1}^{U} G_i B_{ij} G_j + \sum_{i=1}^{U} B_{i0} G \quad (4)$$

2.3.2 Inequality Constraints

Generation Limit Constraint: The generation of each thermal unit is in limit of its maximum and minimum:

$$G_i^{min} \le P_i \le G_i^{max} \quad (5)$$

Emission Operating Limit: The emission from a generating unit is limited. The emission constraint are as:

$$EF(G_i) \le \alpha \times EF^{max} \quad (\alpha < 1) \quad (6)$$

Where α is emission limit factor, EF^{max} is the maximum emission limit at minimum fuel cost. G_i^{min} and G_i^{max} are the minimum and maximum limit of generator output.

The generation should lie within the operating limits of the respective units for their proper operation. Emission constraint indicates maximum limits for emission as indicated:

$$EF2 = \begin{cases} \left(\alpha EF^{max} - EF(G_i)\right)^2 ; EF(G_i) > \alpha \times EF^{max} \\ 0 \quad ; EF(G_i) \le \alpha \times EF^{max} \end{cases} \quad (7)$$

For power balance, equality constraints must be satisfied. The equality constraints represent total power generation should be equal to total power demand plus total line loss.

$$E1 = \begin{cases} \left(\sum_{i=1}^{G} P_i - P_D - P_L\right)^2 ; P_D + P_L \ne \sum_{i=1}^{G} P_i \\ 0 \quad ; P_D + P_L = \sum_{i=1}^{G} P_i \end{cases} \quad (8)$$

2.4 Problem Description

In case of power system load-economic problem optimization we have to find best solutions by considering multi-object functions and evaluating them simultaneously [12]. But in this paper we have included emission as a constraint to get optimize the total generation cost while limiting emission level [13]. But any environmental constraint problem always gives multiple sets of optimal solution with respect to objective function. Objective function includes the operating cost function and summing of penalty term which does n't satisfy equality and inequality constraint. Constraints can be formulated as follows: Minimize CF(G_i)

III. ALGORITHM DESCRIPTION OF HCPSO

In PSO [8], the speed and location of a particle in the search area are given by V and P respectively. Also The velocity of particles are continuously updated using the global best value and personal best experience of the particle i.e. local best value and is given as:

$$V^{k+1}_{i,j} = W \times V^{k}_{i,j} + C_1 \times rand() \times (P^{best}_{i,j} - P^{k}_{i,j}) + C_2 \times rand() \times (G^{best}_{j} - P^{k}_{i,j}) \quad (9)$$

The inertia weight (W) can be expresses as:

$$W = W^{max} - ((W^{max} - W^{min}) \times k)/ITmax \quad (10)$$

The velocity of particles are update using the previous position and velocity in CPSO as given below:

$$V^{k+1}_{i,j} = K[W \times V^{k}_{i,j} + C_1 \times rand() \times (P^{best}_{i,j} - P^{k}_{i,j}) + C_2 \times rand() \times (G^{best}_{j} - P^{k}_{i,j})] \quad (11)$$

Constriction coefficient (K): As $\emptyset$ increases, the factor K decreases and convergence becomes slower [11].

Where $K = 2/|2 - \emptyset - \sqrt{(\emptyset^2 - 4\emptyset)}|$ (12)

When $\emptyset^2 - 4\emptyset \geq 0$ $(\phi = C_1 + C_2 \ , \ \phi > 4)$

The position of particles are update using the previous position and velocity as given below:

$$P^{k+1}_{i,j} = V^{k+1}_{i,j} + P^{k}_{i,j} \qquad (i = 1,2,3 \ldots PR; j = 1,2,3, \ldots \ldots G; k = 1,2,3 \ldots ITmax) \quad (13)$$

Where

ITmax= maximum iteration number

IT = iteration number

W^{min} = final weight.

W^{max} = initial weight

PR= number of particles in group;

G= number of member in particles;

ITmax = number of iteration;

W= inertia weight factor;

C_1 and C_2 = acceleration constant.

$P^{k}_{i,j}$ = current position of jth member of ith particles at k^{th} iteration.

rand()=uniform random number in the range [0,1].

$P^{best}_{i,j}$ = local best position of jth member of ith particles.

G^{best}_{j} = Global best position of jth member.

$V^{k}_{i,j}$ = current velocity of jth member of ith particles at k^{th} iteration.

P^{min}_{j} and P^{max}_{j} Least and Supreme position of jth member.

The major limitation of PSO algorithm is during search process it can't find the best solution when it reaches the local search area since at that point its rate of convergence is slow for exploitation. Similarly CPSO has limited exploration ability for global search condition [2]. That is why HCPSO has been used to overcome the limitation of PSO and CPSO to find optimum solution. The algorithm implementing HCPSO for ECELD is indicated below in the flow chart. Here C factor is constant value after which exploitation is done and reduction in step size.

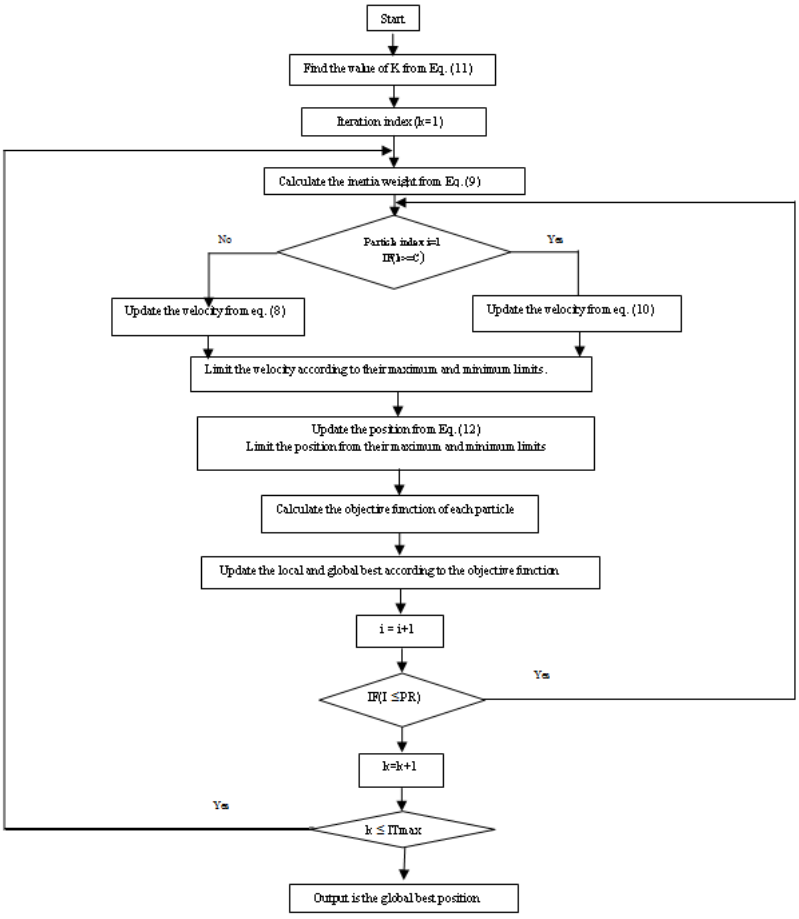

Fig1 Flowchart of Hcpso

IV. ANALYSIS OF THE RESULT

The analysis has been carried out considering six different plant having generating capacity of total 700MW. We have presented here the data regarding optimum generated power per unit plant with only considering to minimize the cost and also considering emission as constraint and selecting the parameter.

For the analysis based on HCPSO to find the stable and optimal solution for ECELD, the program is run for different value of C_1 , C_2, C_3, C_4, w^{max} , w^{min} , ITmax and C factor, which are given in TABLE 1.

The below table indicates a comparison between CPSO, HCPSO and MRPSO. We found that MRPSO have the best emission control but it also have optimum cost among all the other algorithm (PSO, WIPSO) results [16]. But by using HCPSO method we have optimized both cost and emission value with compared to other which is represented below.

Table 1 Different values of Parameters

PR	ITmax	W^{max}	W^{min}	C_1	C_2	C_3	C_4	C factor
50	500	.9	.4	2	2	2.05	2.05	150

Variables	ELD		Emission dispatch		ECELD		
POWER	CPSO	HCPSO	CPSO	HCPSO	CPSO	MRPSO	HCPSO
G_1 (MW)	10.00	11.43	11.84	10.84	11.78	28.941	12.858
G_2 (MW)	28.07	14.30	107.02	111.00	69.00	91.958	72.002
G_3 (MW)	140.12	122.08	64.99	140.32	150.03	108.15	155.203
G_4 (MW)	105.51	83.16	142.67	93.95	124.25	129.80	149.223
G_5 (MW)	144.16	309.22	199.31	173.64	126.29	187.28	190.452
G_6 (MW)	181.21	181.21	189.07	189.07	237.40	179.28	138.115
Cost($/h)	37288.66	37249.06	38305.23	38308.49	37613.96	38051.1	37723.08
Emission(lb/h)	539.79	537.29	468.69	451.87	485.17	460.24	460.209

Table 2 Simulation result of different dispatch using different algorithm.

At first we have only considered cost to be minimized and we have used CPSO and HCPSO algorithm for that purpose. We found out that by using HCPSO we can reduce the generation cost to a minimum value of 37249.06 $/h than compared to that of CPSO which is 37288.66 $/h at the same time the total emission is also reduced from 539.79lb/h to 537.29lb/h. Now we have considered only emission constraint problem and try to minimize total emission at the same load condition. By using CPSO it reduced to 468.69 lb/h while we got a better result of 451.87lb/h by using HCPSO with an additional cost of 3.26$/h. Results of both the algorithm with ELD emission dispatch are presented in the TABLE 2. The above table also indicates a comparison between CPSO, HCPSO and MRPSO .We found that HCPSO not only provides the best emission control that is the total emission value of only 460.209 lb/h but also have least cost of generation 37723.08 $/h among all the other algorithm results. But by using MRPSO method we have optimized combined cost 38051.1 $/h and emission value 460.24 lb/h which indeed provides better result than CPSO but its result is not superior than the results we obtain by HCPSO.

Again we have included emission limiting factor(α) for the purpose of better controlling the total level of emission. For different values of α we have estimated power output of individual plant and the cost and emission at that point.

Table 3 Simulation result of ECELD using HCPSO algorithm.

P_G (MW)	ECELD		
	α =.9	α =.86	α =.84
P_1 (MW)	10.287	12.858	11.11
P_2 (MW)	60.743	72.002	75.01
P_3 (MW)	140.462	155.203	154.39
P_4 (MW)	120.678	149.223	116.43
P_5 (MW)	143.098	190.452	196.05
P_6 (MW)	245.014	138.115	165.09
Cost($/h)	37500.28	37723.08	38084.13

Emission(lb/h)	483.062	460.209	450.28

It is clear from TABLE 3 that with the decrease of α, rate of emission decreases while corresponding cost increases. So we can operate the plant according to our higher priority objective that means if generation cost can be negotiable then we can reduce the emission level further to a lower value by regulating emission limiting factor (α).

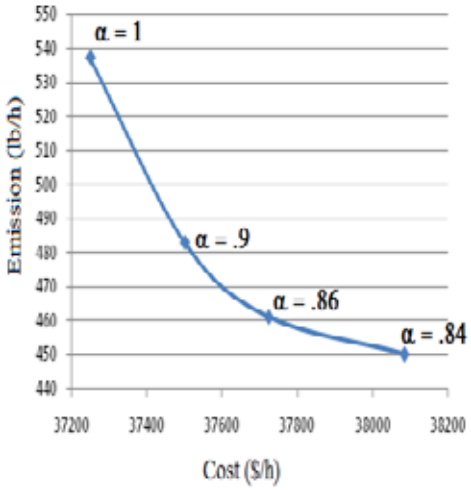

Fig 2 Cost Versus Emission Curve In Six Units

We also found out the power scheduling of different power plants at 700 mw load demand condition by using various control algorithm and we have presented the same in the TABLE 4. From the table we can see that in case of HCPSO the total power generation from the power plant is only 717.848 MW while that in case of CPSO and MRPSO is 718.75 and 725.409 respectively. It indicates the total power generation in case of HCPSO is minimum for the same load demand as compared to that of the other algorithm which implies fewer amounts of power wastage and cost saving for the same amount of power generation which intern also indicates higher efficiency of the plant.

Table 4 Simulation result of cost and power loss of generating unit.

COST($/h)	CPSO(ECELD)	MRPSO(CEED)	HCPSO(ECELD)
CF(G_1)	1231.96	1999.91	1267.03
CF(G_2)	4143.86	5596.22	4327.3
CF(G_3)	7543.90	5636.82	7784.39
CF(G_4)	6544.11	6806.92	7743.95
CF(G_5)	6583.24	9202.53	9343.05
CF(G_6)	11450.81	8793.075	6983.81
Total cost	37497.88	38035.475	37449.52
G_D(MW)	718.75	725.409	717.848
G_L(MW)	18.75	25.409	17.848

The above data is again presented in the following Fig3 for better understanding where we can see the total power loss is minimum in case of HCPSO than compared to that of MRPSO and CPSO. So by using HCPSO not only we can reduce the total cost of power generation, total emission but also we can reduce the unnecessary cost of excess power generation which intern not only increase cost and material saving and overall efficiency of the plant but also reduces the total emission level to a further value.

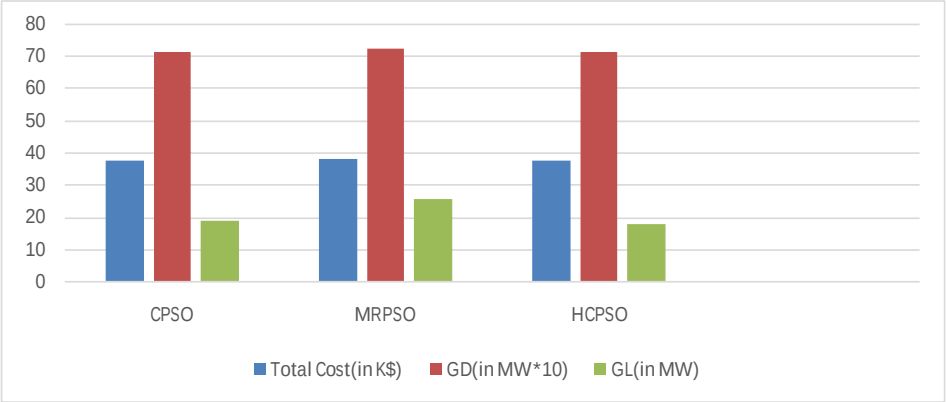

Fig 3 Total Cost, G_d, G_l Of Cpso,Mrpso Vs Hcpso

V. CONCLUSION

From the above analysis we conferred that by using HCPSO algorithm not only we can optimize the cost of power generation but also we can reduce the emission level to a lower level. Also we understood that by implementing this algorithm we can further reduce the emission level by tuning the cost of power generation. Finally this is also verified that this is indeed a algorithm which can be used to reduce the generating cost, emission and also the unnecessary amount of power generation in the power plant and hence enhancing the overall efficiency of the system.

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ZPOLLEN Γ-RAY IRRADIATION: A NOVEL TECHNIQUE IN MULBERRY (*MORUS INDICA* L.) BREEDING

B. Madhumita[1] and G. Padmaja[2]

[1] *Department of Botany, Dasaratha Deb Memorial College, Khowai, Tripura, (India.)*

[2]*Department of Plant Sciences, School of Life Sciences, University of Hyderabad, Hyderabad 500 046, Andhra Pradesh, (India.)*

ABSTRACT

The pollen-irradiation technique was employed in mulberry to observe the possibility of inducing useful variants through in situ parthenogenesis. The pollen of S-13 cultivar was irradiated by gamma rays at doses of 0.05 kGy to 2.0 kGy and used to pollinate the M-5 cultivar. Fruit formation up to 1.0 kGy after 30 days of pollination were observed; however higher dosage resulted in withering of the fruits. The pollen viability tests revealed that irradiation dose above 0.5 kGy was highly lethal and in comparison to control (96.2%), the viability of 1.0 and 2.0 was found to be reduced to 13.7% and 9.8% respectively. Irradiation dosage up to 0.08 kGy had a limited effect only and dosage above 0.1 kGy revealed considerable viability loss and the decrease in germination percentage. Fruits obtained from the irradiated pollens were less in weight and the number of seeds per fruit and seed weight also decreased with the increase in the dose in comparison to the control. The ploidy level of the germinated seedlings did not reveal any differences; however irradiation resulted in some useful variants. Out of 50 M_1 plants established in the field, 21 plants showed variations in the morphological characteristics such as leaf color, size, shape and margin, height of the plant, thickness of the main stem and internodal distance in comparison to control plants. Eight variants were found to be superior with respect to leaf size and one variant viz., Plant 40 exhibited vigorous growth along with large leaf size than parent plant.

Key Words: KGy, Morphological Variants, Morus Indica L., Pollen Irradiation.

I. INTRODUCTION

Mulberry is an important plant fetching a lot of foreign exchange/revenue through silk production since the main diet of silk worm (*Bombyx mori* L.) constitutes the foliage of mulberry. Mulberry, a perennial plant is highly heterozygous and production of homozygous lines through recurrent breeding is not useful due to long generation cycles and high levels of heterozygosity (Hamrick *et al*. 1979 [1]).

Pollen irradiation technique has been employed in plant breeding for the development of haploids, overcoming incompatibility barriers (Pandey, 1974 [2]), gene transformation (Pandey, 1978 [3]), nucleus substitution and generation of useful variants/mutants (Matsukura *et al*., 2007 [4]; Sanamyan *et al*. (2003) [5]. Pollen irradiation can produce new genotypes from the heterozygous variety of mulberry and will be of immense interest for the plant breeders. This technique can be exploited as an alternate and efficient tool for producing useful genotypes in mulberry. Successful production of haploids or double haploids through induced parthenogenesis by irradiated pollen has been demonstrated in several species such as barley (Subramanyan and Kasha, 1976 [6]),

pear (Bouvier *et al*. 1993 [7]), apple (Zhang and Lespinasse, 1991 [8]; Witte and Keulemans, 1994 [9]), muskmelon (Cuny *et al*., 1993 [10]), carnation (Sato *et al*., 2000 [11]), and kiwifruit (Pandey *et al*., 1990 [12]; Chalak and Legave, 1997 [13]). In few of the cases induced parthenogenesis resulted in mutants in F1 generation. Falque (1994) [14], obtained morphologic mutants with 50 Gy irradiated pollen and no haploid was obtained. Khawale *et al*. (2007) [15] observed various types of abnormality symptoms like curling/scorching of leaves, albino leaves, stunted root/shoot growth, chimera formation in chemical mutagen-induced grapevine mutants. Mutations impairing the biosynthesis or sensitivity of gibberellins (GA_3), indole-3-acetic acid and brassinosteroids have been reported (Lanahan and Ho, 1988 [16]; Nadhzimov *et al*. 1988 [17]; Sponsel *et al*. 1997 [18]; Fukuta *et al*. 2004 [19]). This study provides not only a model system for an efficient variety and value-adding system for crop plants but also good material for subsequent breeding and molecular study. To our knowledge, there are no reports on the development of new mulberry varieties using gamma irradiation. The present study was undertaken to establish an efficient irradiation protocol for producing morphological variants in mulberry.

II. MATERIALS AND METHODS

2.1 Plant Material

S-13 cultivar of *Morus indica* L. was used as pollinizer parent. Nodal explants having the male catkins were collected at anthesis stage and irradiated on the same day. The clones of M-5 cultivar were used as female parent.

2.2 Pollen irradiation

The nodal explants along with the male catkins were collected from the field-grown plants of S-13 cultivar and placed in tissue culture bottles containing 20 ml of sterile water to prevent the staminate flowers from drying. Gamma irradiation was carried out by exposing the male catkins to cobalt 60 source at Acharya N.G. Ranga Agricultural University, Hyderabad, India. The pollen of S-13 cultivar (*Morus indica* L.) was irradiated at different doses of 0.05 kGy to 2.0 kGy and used to pollinate the clones of M-5 cultivar.

2.3 Pollination procedure

Unpollinated pistillate flowers of M-5 cultivar were bagged to prevent free pollination. Pollinations were performed on freshly opened isolated flowers of M-5 cultivar. Female flowers were hand pollinated by brushing the receptive stigma with irradiated as well as control pollen. After pollination, the flowers were bagged again to avoid any alien pollination until the styles withered. Some of the unpollinated female catkins were kept bagged throughout the experiment to record any event of spontaneous parthenogenesis or accidental pollination.

2.4 Pollen viability

The viability of the pollen was determined by staining them with Fluorescence Di Acetate (FDA) and Propedium Iodide (PI) stain. Pollens were isolated in 1 ml of 20mM Phosphate buffer saline (PBS) pH 7.5 from the anthers just after irradiation and kept in the stain for 15 min in dark. After the incubation the pollens were centrifuged at 1,000 rpm and the pellet was redissolved in PBS and was observed under fluorescence microscope.

2.5. Seed germination and acclimatization of plants

Fruit set was estimated at 20 days after pollination. Seeds were collected from control as well as from different doses of irradiation and were stored at 4°C until further use. Seeds were germinated to quantify abnormalities in the chromosome number. The germination response of the seeds was evaluated by culturing them in Woody Plant Medium (Lloyd and McCown, 1980 [20]) supplemented by 3 mg/l GA_3. The *in vitro* rooted plants were transferred to plastic pots containing soil and organic manure (3:1) and kept in the greenhouse (26+ 2°C) for 15-20 days. The humidity was maintained by covering with polythene covers. The plants were transferred to earthen pots initially and finally transferred out in field.

2.6 Morphological analysis of M_1 plants obtained after pollination with irradiated pollen

The *in vitro* propagated plants or the seedlings obtained after pollination with control and irradiated pollen along with parents were transferred to soil in the field. In case of S-13 cultivar, the nodal explants with axillary buds were cultured on MS medium with 0.3 mg/l 2,4-D for inducing axillary bud sprouting. The shoots that differentiated from the axillary buds were placed on MS medium with 0.1 mg/l IBA for root induction and then established in soil. The observations on height of the plant, leaf length and width, color, shape, margin, thickness of the main stem and internodal distance was recorded in four-month-old plants. The data on parental plants and control hybrids was an average of ten plants.

2.7 Stomatal index

Stomatal size and frequency was screened from the M_1 plants obtained from irradiated pollen along with control plants for any variation. The fully expanded leaves (third from the shoot apex) collected from M_1 plants along with controls were cut into 3 mm^2 pieces and fixed in 2.5 % glutaraldehyde in 0.1 M phosphate buffer, pH 7.0 overnight at 4°C. Specimens were rinsed, dehydrated in an ethanol series, critical point dried before being mounted on copper stubs, and sputter coated with gold. The coated specimens were examined in scanning electron microscope (Phillips XL30 ESEM) at CIL, University of Hyderabad, Hyderabad. Ten specimens prepared from different regions of the same leaf were used for determining stomatal length and width and these were studied at least 3 times.

2.8 Chloroplast Index

Thin leaf epidermal peals were taken from control and irradiated plants and were screened for the number of chloroplasts/stomata.

III. RESULTS

The effect of gamma irradiation on pollen germination, mitotic division, embryo and endosperm development, fruit set and seed set were studied. The irradiation studies revealed that it had a pronounced effect on the pollen viability. There was a sharp decline in pollen viability at higher irradiation dose in comparison to control. The pollen viability tests revealed that irradiation dose above 0.5 kGy were highly lethal and in comparison to control (96.24%) the viability of 1.0 and 2.0 was reduced to13.72%, and 9.84% respectively (Fig. 1; Table 1)

The reduction in pollen viability had a direct effect on the number of seeds produced. Fruit formation up to irradiation dosage of 0.5 kGy after 30 days of pollination was observed; however higher dose of irradiation caused withering of fruits. With the increase in irradiation dosage the fruit size, fruit weight, number of seed/fruit, and seed weight decreased in comparison to control. Pollinations with 2.0 kGy resulted in either

withering of female catkin or parthenocarpic fruit formation without any seed set, which may be due to the failure of pollination. This observation was also supported by the pollen viability test (9.84% for 2.0 kGy). This indicates abnormal seed development leading to the abortion of embryo and decreased seed set. The lack of seed set from the unpollinated flowers indicated that there was no spontaneous parthenogenesis, and that the possibility of accidental pollination during the experiment was ruled out.

Seedlings obtained from the irradiated pollen were germinated to screen for the any variants and showed marked difference in germination percentage in comparison to the control. Germination percentage declined with increase in irradiation dose to as low as 9.4%. This result suggests that most of the seeds were not viable and presumably empty. Germinated seedlings were acclimatized under green house conditions and subsequently transferred to the field.

The genetic change in the pollen DNA due to irradiation may influence the degree of embryo lethality that is directly revealed in their germination. In the *in vitro* conditions no abnormalities were noticed. To assess the variation, field performances of the rooted plants were taken up. Data recorded on the transferred plants (control and irradiated) established in the field revealed difference in morphology (Table 2). Out of 50 M_1 plants established in the field, 21 plants showed variations in the morphological characteristics such as leaf color, size, shape and margin, height of the plant, thickness of the main stem and internodal distance in comparison to control plants. The interesting observation in the present study is that Plant 40, showed superior performance in terms of leaf size and growth when compared to control plant. The leaf size of Plant 40 was found to be larger than the control hybrid as well as the parental plants (Fig. 2). Five plants were found to be superior to control diploid plants with respect to leaf size. The other prominent changes observed were lanceolate leaves, elliptical shaped leaves, pale green leaves, leaves with dentate margin, five lobed leaves and bicrenate leaf margin and slow growth with reduced height. Out of the 50 M_1 plants established in the soil, eleven plants exhibited flowering in 1½ year whereas no flowering was observed in the control plants during this period.

Scanning electron microscopic studies of leaf surface of plants obtained after pollination with control and irradiated pollen were carried out. The stomatal length of control was 31.8 µm whereas it ranged from 17.6 – 25.2 µm in plants obtained after pollination with different doses of irradiation. The stomatal length of Plant 40 was 17.6 µm (Fig. 3)

The chloroplast number in the guard cells of the stomata was determined in plants obtained after pollination with control and irradiated pollen. The control plants had 9.4 chloroplasts per stomata. The chloroplast number in the plants derived from irradiated pollen varied from 5.8-9.4. Plant 40 had 5.8 chloroplasts per stomata (Fig. 4).

IV. DISCUSSION

In the present investigation pollen irradiation has been used to produce variants in mulberry. Irradiation had a pronounced effect on the pollen viability of S-13 cultivar which decreased with the increase in irradiation dose. Similar observations have been recorded by European plum where all the levels of irradiation tested had a significant effect on pollen viability. The radio sensitivity of the pollen varies with the species. Zhang and Lespinasse, 1991 [8] reported that irradiation level up to 1000 Gy had no significant effect on pollen viability. Visser and Oost, 1980 [21] reported that apple and pear pollen germination and tube growth was insensitive to high doses of irradiation. On the contrary Piexe *et al*. (2000) [22] observed that all the levels of irradiation had considerable effect on pollen viability.

Cuny *et al*. (1993) [10] reported that higher doses of irradiation (1.6 kGy) reduced the germination of muskmelon pollen *in vitro*. Piexe *et al*. (2000) observed that all the levels of irradiation had considerable effect on pollen viability. On the contrary, Zhang and Lespinasse, (1991) [8] reported that irradiation level up to 1000 Gy had no significant effect on pollen viability. Visser and Oost, (1980) [21] reported that apple and pear pollen germination and tube growth was insensitive to high doses of irradiation.

Irradiation also had a direct effect on fruit and seed set. With the increase in irradiation dosage the fruit size, fruit weight, number of seed/fruit, and seed weight decreased in comparison to control. Higher irradiation dosage (2.0 kGy) resulted in either withering of female catkin or parthenocarpic fruit formation without any seed set. This observation can be supported by the pollen viability test (9.84% for 2.0 kGy). This indicates abnormal seed development leading to the abortion of embryo and decreased seed set. Witte and Keulemans (1994) [23] reported that the fruit and seed set reduced after pollination with irradiated pollen and concluded that lower fruit set after pollination with irradiated pollen could be due to the lower sink activity of induced seeds compared to fertilized seeds.

Irradiation also effected seed germination of mulberry. Germination percentage declined with increase in irradiation dose to as low as 9.4%. This may be due to the accumulation of deleterious recessive genes (Zhang and Lespinasse, 1991) [8]. Chalak and Legave (1997) [13] reported that the genotype of male had a marked effect on the number of seeds formed although the lowest dose of 200 Gy produced a drastic decrease in the number of full seeds. In majority of the species studied, an increase in the irradiation dose resulted in a significant decrease in the number of seeds per fruit (Chyi *et al* 1984 [24]; Sanford *et al*. 1984 [25]). However, Cuny *et al*. (1993) [10] noted that gamma ray dose did not have any significant effect on number of seeds per fruit. Anatomical studies of the ovule revealed abnormalities in higher dosage. Twin embryos were observed within a single embryo sac indicating the possible induction through parthenogenesis. Berzonsky *et al*., (2003) [26] also reported twin embryo formation in wheat. Nicoll *et al*. (1987) [27], reported nuclear abnormalities, enhanced number of polyploidy restitution nuclei, bridges between nuclei and disrupted mitotic synchrony. Musial and Przywara, 1999 [28] studied the endosperm response to pollen irradiation in kiwifruit and observed that pollination with irradiated pollen yielded endosperm with low amounts of storage products and is autonomous and represented the 2n level. Peixe *et al*. 2000 [22] also reported abnormal embryo development in European plum. Falque (1994) [14] revealed that embryo development in cacao was altered by irradiation whereas the endosperm development was normal. James *et al*. (1985) [29] and Nicoll *et al*. (1987) [27] observed that high levels of radiation resulted in the formation of seeds just with endosperm or with endosperm and embryos in apple.

Morphological characterization is the first step in description and classification of crop germplasm because breeding programme mainly depends upon magnitude of genetic variability (Smith *et al*. 1991) [30]. Qualitative characters are important for plant description. The mutations induced by gamma irradiation in the male genome might have an effect on the morphology of M_1 plants (Dai and Magnusson, 2012 [31]). The M_1 plant arising from pollination with mutated pollen is non-chimeric and will be hemizygous for any uniquely induced mutations (Yang *et al*. 2004 [32]). Germinated seedlings obtained from intervarietal crosses showed high variation in morphological characters such as the height of the plant, number of main branches, leaf colour, shape, margin, size, internodal distance, leaf yield per plant in comparison to the control. It is probable that most of the stable phenotypic changes induced by ion beam irradiation were caused by the direct modification of

endogenous genes closely related to the altered phenotypes, while unstable phenotypic changes might be induced by some indirect effect, such as a physiological change in the cells or an altered response to environmental conditions. Falque (1994) [14] observed various abnormalities in the morphology in M_1 plants of cacao, often with long and irregular leaves in obtained after pollination and fertilization of irradiated pollen. These apparent mutants were found with a rate of about 20% among the progeny from 50 Gy irradiated pollen whereas in our experiments the changes in morphology were observed for all the doses examined. It is essential to study the inheritance of the mutations in order to understand the nature of mutations. It is highly likely that undetected mutants remained because deficient screening. The underlying cause for the morphological variants remains unknown. It may be possible that pollen irradiation might have caused alteration of the genes giving rise to hemizygous plants expressing some recessive maternal genes, as reported with *Oryza sativa* (Chin and Gordon, 1989 [33]). Falque (1994) [14] observed various abnormalities in the morphology, often with long and irregular leaves in M_1 plants of cacao obtained after pollination and fertilization of irradiated pollen. These apparent mutants were found with a rate of about 20% among the progeny from 50 Gy irradiated pollen whereas in our experiments the changes in morphology were observed for all the doses examined. It is essential to study the inheritance of these traits in order to understand the nature of mutations. It is highly likely that undetected mutants remained because of deficient screening. Further screening and analysis on a large scale will yield additional variants. Sanamyan (2003) [5] reported plants with reduced fertility and a haploid plant in M_1 cotton plants and suggested that diverse forms observed in M_1 after pollination with irradiated pollen is determined by elimination of some chromosomes and also by interchromosomal rearrangements. Low and medium doses of γ-rays caused relatively high proportion of useful mutants with normal yielding properties (Matsukura *et al*., 2007) [4]. Gamma ray mutagenesis can be expected to yield severe phenotypic mutations because it causes large-scale deletions and occasionally, chromosome reconstitution (Matsukura *et al*., 2007) [4].

In the present study, two M_1 plants showed a considerable decrease in height compared to parents. Researchers studying other crop species have also reported a decrease in height on exposure to the mutagens. Khawale *et al*. (2007) [15] observed various types of abnormality symptoms like curling/scorching of leaves, albino leaves, stunted root/shoot growth, chimera formation in chemical mutagen-induced grapevine mutants. Many dwarf mutants in hormone biosynthesis and signaling have been identified (Hentrich *et al*. 1985 [34]; Noguchi *et al*. 1999 [35]; Symons *et al*. 2002 [36]). This has been particularly so for the gibberellins (GA_3) (Nadhzymov *et al*. 1988 [37]), auxin (IAA) (Symons *et al*. 2002 [36]) and brassinosteroids (BR) (Noguchi *et al*. 1999 [35]). GA_3, IAA and BR are plant growth regulators controlling cell and plant size, and mutations impairing their biosynthesis or sensitivity result in dwarfism (Lanahan and Ho, 1988 [16]; Nadhzimov *et al*. 1988 [37]; Sponsel *et al*. 1997 [18]; Fukuta *et al*. 2004 [19]).

Several factors like irradiation dose, state of the generative nucleus and the ability of the nucleus to divide determine successful production of parthenogenic seeds. The results obtained from the above study indicate that occurrence of parthenogenic seeds is genotype and dose dependent. Pollen irradiation technique can be an efficient method to obtain useful variants in highly heterozygous mulberry. Their production through induced parthenogenesis through pollen irradiation is very promising. Pollen irradiation can induce a drastic change in the crop and shorten the period required for breeding new varieties (Rai *et al.* 2014 [38]). Irradiation technique provides high phenotypic variations without severe growth inhibition at relatively low doses. Thus, it can be

envisaged that irradiation is an excellent tool for creating genetic variability in mulberry and recovering promising variants.

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Table 1: Effect of irradiation on the viability of S-13 pollen

Dose of irradiation (kGy)	% Viability
Control	96.24 ± 1.21e
0.05	60.44 ± 1.88 d
0.08	57.56 ± 1.68 d
0.1	40.51 ± 1.22 c
0.5	28.06 ± 2.98 b
1.0	13.72 ± 1.19 a
2.0	9.84 ± 0.59 a

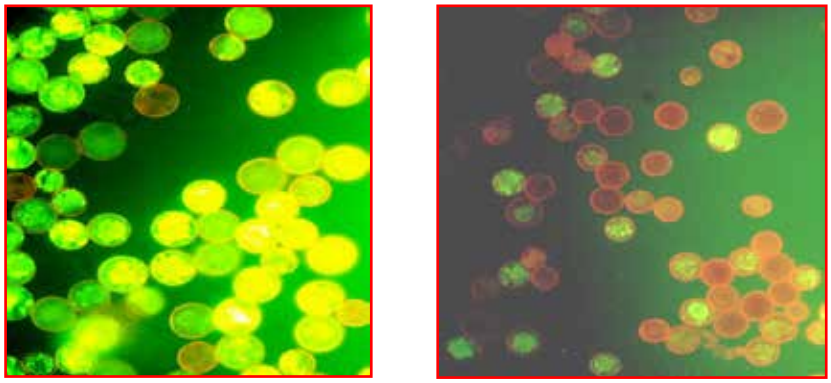
Means followed by the same letter in a column are not significantly different ($p < 0.05$) by Newman-Keul's multiple range test.

Table 2: Morphological variations in M_1 plants of mulberry obtained after pollination with S-13 irradiated pollen

Plant Number	Dose of irradiation (kGy)	Height of the plant (cm)	Leaf length (cm)	Leaf width (cm)	Thickness of the main stem (cm)	Internodal distance (cm)	Remarks
Control	**--**	**135.8 ± 10.5**	**15.3 ± 0.7**	**11.4 ± 0.5**	**2.8 ± 0.3**	**4..0-5.0**	**Ovate leaves**
14	**0.08**	**145.2**	**17.0**	**12.0**	**3.0**	**5.0-5.5**	**Large leaves**
15	**0.05**	**152.0**	**15.5**	**10.5**	**2.4**	**4.5-6.5**	**Leaf margin dentate**
16	**0.1**	**100.0**	**17.0**	**12.3**	**2.5**	**5.0-5.5**	**Pale green**

							leaves
20	0.1	110.0	20.0	16.0	2.8	4.5-5.0	Pale green leaves
22	0.08	69.0	12.0	10.0	2.0	4.0-4.5	Short height
23	0.1	95.0	12.0	9.4	2.0	3.5-4.0	Small leaves
27	0.08	90.0	9.5	8.4	2.0	4.0-5.0	Small leaves
32	0.1	88.0	16.5	12.5	2.8	4.0-4.5	Lanceolate leaves
33	0.08	125.0	19.0	14.0	3.0	4.0-5.0	Large leaves
34	0.08	148.0	23.0	17.0	3.2	5.0-5.5	Large leaves
36	0.08	82.0	18.0	12.5	1.8	4.0-5.0	Small leaves
37	0.08	74.0	13.0	9.5	2.5	4.0-5.0	Short height
38	0.08	100.0	11.3	9.2	3.0	5.0-6.0	Small leaves
40	0.08	170.0	21.0	14.0	3.5	5.0-6.0	Very large leaves
45	0.08	150.0	18.0	11.2	3.0	3.0-4.0	Large leaves
46	0.05	54.0	12.8	9.0	1.5	4.0-4.5	Small leaves
52	0.08	70	9.3	8.0	1.8	3.5-4.0	Short height
55	0.08	86	14.5	12.5	2.5	4.5-5.0	Short height
57	0.08	90	15.0	10.0	2.3	4.0-4.5	Elliptical leaves

63	**0.1**	**145**	**17.5**	**15.0**	**3.5**	**4.0-4.5**	**Large leaves**
72	**0.05**	**78**	**15.0**	**12.0**	**1.5**	**4.5-5.0**	**Small leaves**

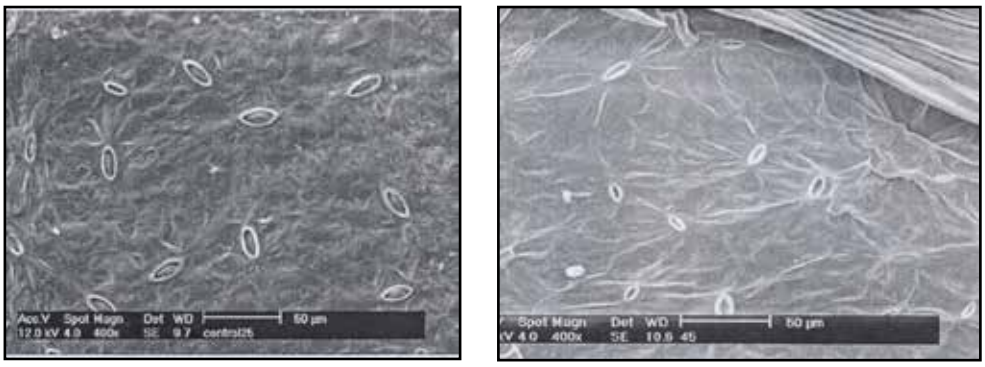


Control Pollens Irradiated Pollens (1.0 kGy)

Fig.1. Pollen Viability of control and 1.0 kGy irradiated pollen with FDA and PI stains.

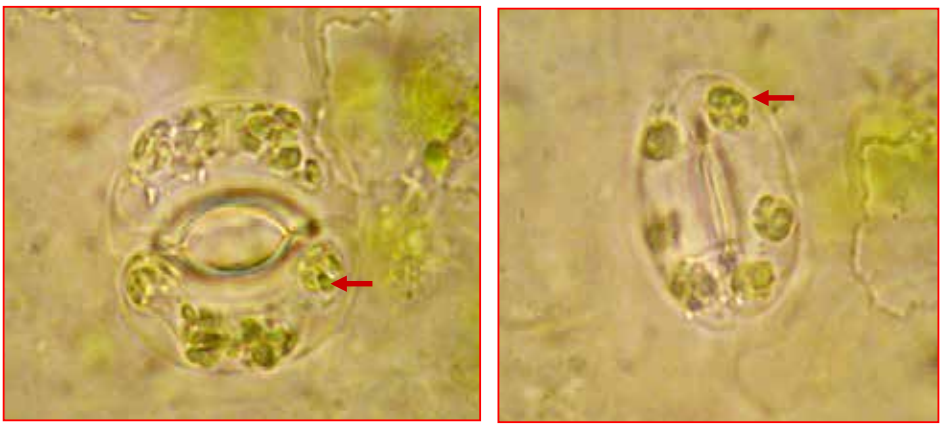
Control Plant 40

Fig. 2 Comparison of leaf size of Plant 40 in comparison to parent plant.



Control Plant 40

Fig. 3. Scanning electron micrographs of leaf surface of Plant 40 in comparison to parent plant.



Control Plant 40

Fig. 4. Comparison of stomatal chloroplast of Plant 40 and parent plant.

APPLICATIONS OF BIG DATA ANALYTICS AND DATA MINING IN HEALTH CARE SECTOR

Ms.S. Gomathi[1], Dr. V. Narayani[2]

[1]Research Scholar, Research and Development Centre, Bharathiar University,
Assistant Professor, Sri Krishna Arts and Science College, Coimbatore,(India)
[2]Director I/C, Department of MCA, Karpagam College of Engineering, Coimbatore, (India)

ABSTRACT

Data Mining is an ever growing field which is used to extract the hidden information using some special techniques and algorithms. Data mining is applied in important sectors like health care, customer relationship management, marketing, ecommerce, fraudulent, insurance, banking etc. The availability of data from these fields are enormous which needs terabytes and zettabyte of storage is required to store the files and need an efficient method to access those files efficiently with degradable system performance. Big data is an emerging field which is used to store centralized semi structured and unstructured data. Thus the paper highlights the application of Big Data and Data Mining in the healthcare sector.

Keywords: Data Mining, Big Data, Hadoop, algorithms, diseases

I. INTRODUCTION

Health care sector handles large data which is most important to store the details about the patients. Thus those big data cannot be handled manually. Digitizations of the record are important so as to access it efficiently in future. Decision making and timely deliver is another vital role in health care sector. Patients always depend on the decision of the doctors which mostly depends on the analysis [1,3]. Hence big data in health care is large and complex which are complex to manage using the existing software and database technologies. Big data includes the data from physician's notes, administrative data, medical imaging, insurance, prescriptions, electronic patient records, twitter feeds, social media, and blogs and so on [4]. Thus big data is used potentially to improve care, decision making, and lower costs and save lives. Data mining is an important and efficient technique which is used to mine the data from the complex and hidden patterns [2,5]. Data mining is perfectly used in health care sector to mine the hidden patter. Data comes from many sources which may be heterogeneous, autonomous and complex. The data is not only the texts, it can be in the form of images, audio, video, phrases, maps etc., Finding the useful information from the unwanted data is the most important task in health care sector. Normal database can hold only some Mega bytes to Gigabytes of information. If data mining is used along with the big data then the storage of data and extracting of information will be made easier and optimized [6,9].

II. SOURCES OF BIG DATA

Big data can handle three types of data.

a) Structured data

b) Semi structured data

c) Unstructured data

Figure 1. Various Sources of Big data [10]

Structured Data: The easy categorization of data are called as structured data. Eg. Numbers and texts. The normal human readable form of data are called as structured data [7,10].

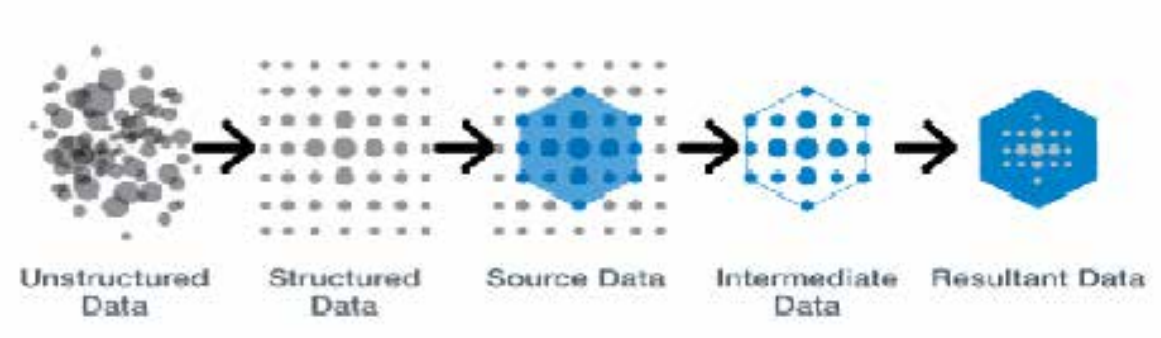
Semi Structured Data: Social media feeds and web logs are called as semi structured data. Data which does not conform to an explicit or fixed schema. The data is described with the tags and hierarchies of records [7].

Unstructured Data: Critical information such as commercial website, customer reviews, photos, comments, social networking sites, multimedia and videos are categorized to be unstructured data [8].

Other Sources: The other sources are drug research, gene sequencing, test result, claims, home monitoring, census data, health reports, billing reports etc [9].

Figure 2: Transformation of structured and unstructured data into resultant data [10]

Figure 2 shows how structured and unstructured data are transferred to resultant data by big data analytics nique.



III. CHARACTERISTICS OF BIG DATA

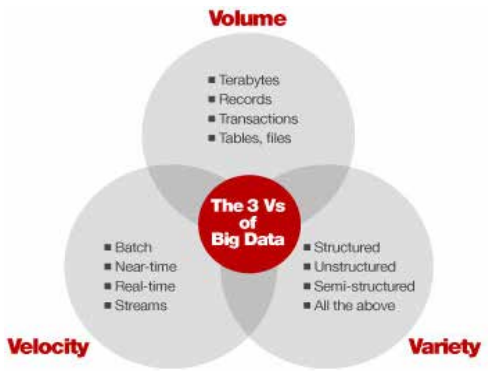


Figure 3: The Characteristics of Big data (3 V's of Big data) [11]

The three V's of big data are the main characteristics which are Volume, Variety and Velocity. Figure 3 shows the 3 V's of Big data.

Volume: Volume means storage capacity. Collection of large amount of data, records, transaction and tables in terabytes to peta bytes .

Variety: The types of data used to store in big data is called variety. The types may be text, click stream, web logs, video, images, audio, animation, legacy documents, sensor data and so on. All these types are classified under structured, semi structured and unstructured data [11].

Velocity: The rapid generation of data from time to time is called velocity. The data may be real time data, near real time data, yearly data, monthly data, hourly data, historical data, weekly data and so on.

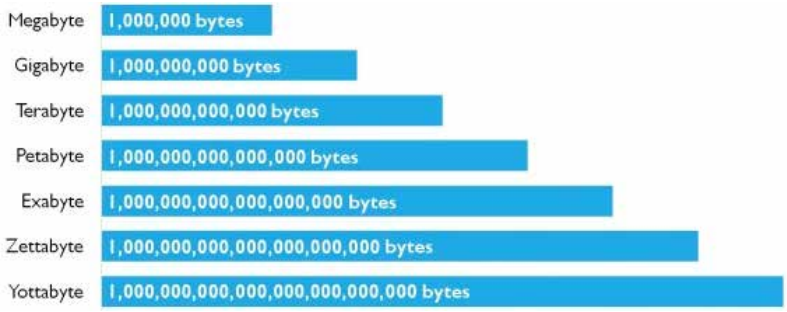


Figure 4: Volume– S0trage Capacity of Big Data

IV. CHALLENGES OF BIG DATA

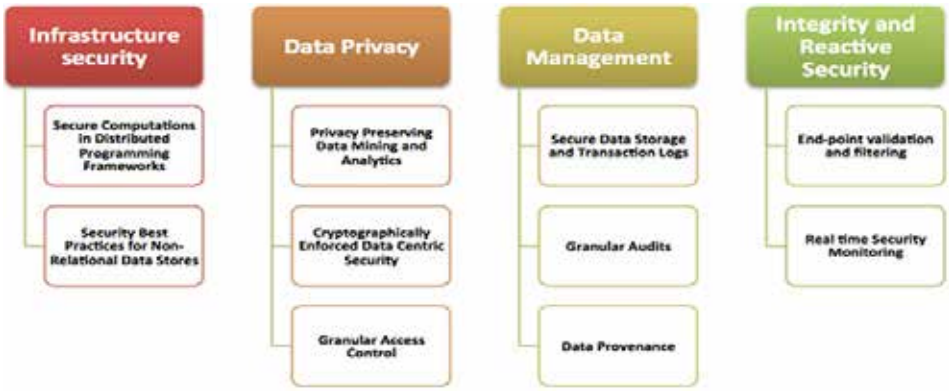


Figure 4: Challenges of Big data [12]

The major challenges faced while implementing big data are infrastructure security, data privacy, data management and integrity & data security.

a) **Infrastructure Security:** These types of security covers the major issues like security best practices for non-relational data stores and secure computations in distributed programming framework [12].

b) **Data Privacy:** This type of challenges includes privacy preserving data mining and analytics, cryptographically enforced data centric security and granular access control [12].

c) **Data Management:** This challenges includes secure data storage and transaction logs, granular audits and data provenance [12].

d) **Integrity and reactive security:** These challenges includes end point validation and filtering and real time security monitoring [12].

V. HADOOP – AN EFFICIENT TOOL FOR BIG DATA

Hadoop is a open source, Java-based programming framework which supports the processing of large data sets in a distributed and centralized computing environment. A part of the Apache project is Hadoop [13]. The base Apache Hadoop framework is composed of the following modules: Hadoop Common, Hadoop Distributed File System (HDFS), Hadoop YARN and Hadoop MapReduce [14].

VI. CONCLUSION

Health care is the fastest and richest availability of data. Maintaining the data and extracting the necessary information is most important to care the patients and understand the patients behavior and occurrences of disease. Thus an efficient technique is necessary to manage the huge varieties of data. Big data is the one which can handle the data efficiently. This paper summarizes the use of big data and data mining in health care sector. The future study will be to implement the big data to some particular problem in health sector field, analyzing the results and making them more clear about the purpose of big data in health care.

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DESIGN & FABRICATION OF HUMAN POWERED MULTI-PURPOSE MACHINE: A REVIEW

Rakesh Ambade[1], Akash Pande[2], Prasad Sangitrao[3], Rahul Katre[4], Pavan Bisen[5]

[1]Assistant professor, [2,3,4,5]Undergraduate Students, Dept. of Mechanical Engineering
Jawaharlal Darda Institute of Engineering &Technology Yavatmal, Maharashtra, (India)

ABSTRACT

This paper presents the concept of Human Powered Multi-Purpose Machine mainly carried out for production based industries. Industries are basically meant for Production of useful goods and services at low production cost, machinery cost and low inventory cost. Today in this world every task have been made quicker and fast due to technology advancement but this advancement also demands huge investments and expenditure, every industry desires to make high productivity rate maintaining the quality and standard of the product at low average cost. We have developed a conceptual model of a machine which would be capable of performing different operation simultaneously, and it should be economically efficient .This machine can be used in remote places where electricity is irregular or insufficient. It is designed as a portable one which can be used for cutting in various places. It can be used for operating on materials like thin metals,wood and p.v.c.The material can be cut without any external energy like fuel or current. Since machine uses no electric power and fuel, this is very cheap.Energy is the most vital aspect in the development of modern technological civilization. In the present work, a human powered multipurpose machine is developed which can perform three types of operations drilling, sawing and grinding. Power required for pedalling is well below the capacity of an average healthy human being. The system is also useful for the work out purpose because pedalling will act as a health exercise and also doing a useful work.

Keywords: Drilling, Grinding, Multipurpose, Sawing, Pedal Operated

I. INTRODUCTION

Industries are basically meant for Production of useful goods and services at low production cost, machinery cost and low inventory cost. Today in this world every task have been made quicker and fast due to technology advancement but this advancement also demands huge investments and expenditure, every industry desires to make high productivity rate maintaining the quality and standard of the product at low average cost In an industry a considerable portion of investment is being made for machinery installation. So in this paper we have a proposed a machine which can perform operations like drilling, sawing, grinding, some lathe operations at different working centers simultaneously which implies that industrialist have not to pay for machine performing above tasks individually for operating operation simultaneously.

Economics of manufacturing: According to some economists, manufacturing is a wealth-producing sector of an economy, whereas a service sector tends to be wealth-consuming. Emerging technologies have provided some new growth in advanced manufacturing employment opportunities in the Manufacturing Belt in the United States. Manufacturing provides important material support for national infrastructure and for national defense.

II. NEED OF DEVELOPMENT OF MACHINE

In the present scenario machines are electrically driven. Machine with electric motor are faster but that are costly as well as required electricity. The unit operating by means of electricity has limited applications in the rural area. In remote and interior places like in our Vidharbha where there is no facility of electricity as well as in urban areas, while in the duration of load shading or during electrical power-off timings, this type of human power operated unit will have very extensive utility. Therefore this human powered machine is having extensive utility in such areas. Also it reduces the machining equipment cost as three machines can be used simultaneously on same platform.

III. LITERATURE REVIEW

The surveys of the literature regarding the Pedal driven machines are listed:

Dharwa Chaitanya Kirtikumar **[1]** designed and developed a multipurpose machine which does not require electricity for several operations like cutting, grinding etc. This is a human powered machine runs on chain drives mainly with human efforts. But if you wanted to operate this machine by electric power this machine can also does that. It has some special attachment so use both human power as well as electric power. The design is ideal for use in the developing world because it doesn't require electricity and can be built using metal base, chain, pulley ,rubber belt, grinding wheel, saw, bearing, foot pedal (for operated by human) ,electric motor, chain socket.

S.G.Bahaley, Dr. A.U. Awate, S.V. Saharkar **[2]** designed and fabricated a pedal powered multipurpose machine. It is a human powered machine wich is developed for lifting the water to a height 10 meter and generates 14 Volt, 4 ampere of electricity in most effective way. Power required for pedaling is well below the capacity of an average healthy human being. The system is also useful for the work out purpose because pedaling will act as a health exercise and also doing a useful work.

Linxu, Weinan Bai, Jingyu Ru,Qiang Li **[3]** designed and developed an automatically reciprocating pedal powered electricity generator (ARPPEG) in conjunction with the management and control over harvesting the kinetic energy, electricity generation, electric storage and the output of electricity. According to the operation testing results, this system has been proved to effective in power generation. In view of the simple structure and low costs of this system without territory and time limits, the application of ARPPEG designed by them could open a new path to saving the energy and helping build a new energy society.

Heinrich Arnold1 November 2001: Rather long re-investment cycles of about 15 years have created the notion that innovation in the machine tool industry happens incrementally. But looking at its recent history, the integration of digital controls technology and computers into machine tools have hit the industry in three waves of technology shocks. Most companies underestimated the impact of this new technology. This article gives an overview of the history of the machine tool industry since numerical controls were invented and introduced and

analyzes the disruptive character of this new technology on the market. About 100 interviews were conducted with decision-makers and industry experts who witnessed the development of the industry over the last forty years. The study establishes a connection between radical technological change, industry structure, and competitive environment. It reveals a number of important occurrences and interrelations that have so far gone unnoticed.

Dr. Toshimichi Moriwaki (2006): Recent trends in the machine tool technologies are surveyed from the view points of high speed and high performance machine tools, combined multifunctional machine tools, ultra precision machine tools and advanced and intelligent control technologies.

Frankfurt-am Main, 10 January 2011. : The crisis is over, but selling machinery remains a tough business. Machine tools nowadays have to be veritable "jack of all trades", able to handle all kinds of materials, to manage without any process materials as far as possible, and be capable of adapting to new job profiles with maximized flexibility. Two highly respected experts on machining and forming from Dortmund and Chemnitz report on what's in store for machine tool manufacturers and users.

Multi-purpose machines are the declarations of independence. The trend towards the kind of multi-purpose machining centers that are able to cost efficiently handle a broad portfolio of products with small batch sizes accelerated significantly during the crisis. "With a multi-purpose machine, you're less dependent on particular products and sectors", explains Biermann

IV PROPOSED METHODOLOGY

In this project we are supplying power to shaft by means of bicycle pedals mechanism containing one big sprocket and one small sprocket which is fitted on shaft and chain on sprockets helps to rotating shaft, on which a pulleys are mounted on it by means of pedal chain sprocket arrangement. One pulley transmits power by v belt to the grinding wheel under it and also by link attachment the power is transmitted to the hacksaw frame (rotatory motion is converted to reciprocating motion). Also other pulley transmits power by v belt to the drilling attachment.

4.1 Working Principle

There are only two major principles on which our proposed machine generally works:

1. Scotch-Yoke mechanism: It converts rotary motion to recioprocating motion of hacksaw which is used for cutting operation i.e. sawing.
2. Power transmission through v belt and pulleys: It transmits power through the v belt and pulley to the drilling and grinding attachments.

V CONCLUSION

We can see that all the production based industries wanted low production cost and high work rate which is possible through the utilization of multi-function operating machine. It requires less power as well as less time, since this machine provides working at different center it really reduced the time consumption up to appreciable limit.

In an industry a considerable portion of investment is being made for machinery installation. So in this paper we have proposed a machine which can perform operations like drilling, cutting, grinding at different working centers simultaneously which implies that industrialist have not to pay for machine performing above tasks individually, since this machine will perform different operation simultaneously This machine can be used in remote places where electricity is irregular or insufficient. It can be used for light duty cutting and drilling operations of plywood. also the grinding operation can be used to sharp the tools edges as well as to remove extra materials Its working can be done in less floor space. Unskilled labour can also handle it efficiently becouse of this we can reduce the cost of production which is the most important factor in production industry.

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A STUDY OF BEARING AND ITS TYPES

Chetan P. Chaudhari[1], Bhushan B. Thakare[2], Saurabh R. Patil[3], Shrikant U. Gunjal[4]

[1, 2, 3] U. G. Students,[4] Assistant Professor, Department of Mechanical Engineering, Sandip Foundation's- SITRC, Mahiravani, Trimbak Road, Nashik, Maharashtra, Savitribai Phule Pune University (SPPU), Maharashtra,(India)

ABSTRACT

A bearing is a machine element which supports another moving machine element (known as journal). It permits a relative motion between the contact surfaces of the members, while carrying the load. A little consideration will show that due to the relative motion between the contact surfaces, a certain amount of power is wasted in overcoming frictional resistance and if the rubbing surfaces are in direct contact, there will be rapid wear. In order to reduce frictional resistance and wear and in some cases to carry away the heat generated, a layer of fluid (known as lubricant) may be provided. The lubricant used to separate the journal and bearing is usually a mineral oil refined from petroleum, but vegetable oils, silicon oils, greases etc., may be used. Bearings can be split into two groups: Rolling bearings and Sliding bearings. Rolling bearings attempt to eliminate friction and sliding between surfaces in a junction by introducing interfaces such as balls or rollers which rotate or roll in as opposed to sliding. Examples of this type of bearings are axial ball and roller bearings.

Keywords: Machine element, Relative motion, Frictional resistance, Rubbing surfaces, Lubricant, Rolling bearing, Sliding bearing.

I. INTRODUCTION

Due to early industrial necessity for bearings, many thrust pad bearings were theoretically studied in the 1950s by investigators for design and development of good performing bearings. It has been observed that in the past many researchers [1–6] have analyzed thrust bearings having various surface profiles on the pads. Charnes et al. [1] have reported higher load carrying capacity with stepped pad thrust bearing in comparison to the conventional plane inclined thrust bearing. Authors performed adiabatic analysis and have reported reduction in temperature with stepped pad thrust bearing in comparison to plane thrust bearing. Abramovitz [2] studied the effects of pad curvatures on thrust bearing performances. Bagci and Singh [5] and Gethin [6] have reported that the film shapes have considerable influence on the bearing performances. Anant Pal Singh [7] has investigated effects of continuous circumferential surface profiles on the performance characteristics of a sector-type thrust bearing. A computer-aided finite difference numerical solution of the Reynolds equation in polar form is used to determine pressure distributions for an optimum inclination of a sector pad. He reported that As compared with conventional taper fluid film shape, new surface profile (cycloidal, catenoidal, exponential, polynomial) are found to offer a significant increase in the load-carrying capacity as well as a considerable reduction in the coefficient of friction.

Hargreaves [8] has studied theoretically and experimentally the effects of surface waviness over the load carrying capacity of finite slider bearing. The author recorded enhanced load carrying capacity in the presence

of surface waviness on the stationary pad. Das [9], Naduvinamani et al. [10], and Dobrica and Fillon [11] have reported that the shape of the converging wedge influences the bearing performance significantly. Researchers [10] have investigated infinitely wide rough slider bearings isothermally for exponential, hyperbolic, and secant film shapes using couple stress fluids. The authors have reported that the increase in pressure is more for the exponential and hyperbolic sliders. Moreover, investigators [11] have studied the THD behaviour of a slider bearing having a pocket and reported that the maximum pressure is higher for the pocketed bearing in comparison to plane slider bearing. Andharia et al. [12] studied the influence of film shape on the performance of longitudinally rough, infinitely wide slider bearing for isothermal conditions. Andharia et al. [13] have reported better load carrying capacity with exponential, secant, and hyperbolic film shapes in comparison to the inclined plane film shape.

II. TYPES OF BEARINGS

The sliding contact bearings, according to the thickness of layer of the lubricant between the sliding surfaces are classified as follows:

2.1 Thick Film Bearings

The thick film bearings are those in which the working surfaces are completely separated from each other by the lubricant. Such type of bearings is also called as *hydrodynamic lubricated bearings.*

2.2 Thin Film Bearings

The thin film bearings are those in which, although lubricant is present; the working surfaces partially contact each other at least part of the time. Such type of bearings is also called *boundary lubricated bearings.*

2.3. Zero Film Bearings

The zero film bearings are those which operate without any lubricant present.

2.4. Hydrostatic or Externally Pressurized Lubricated Bearings

The hydrostatic bearings are those which can support steady loads without any relative motion between the journal and the bearing. This is achieved by forcing externally pressurized lubricant between the members.

III. HYDRODYNAMIC LUBRICATED BEARINGS

In hydrodynamic lubricated bearings, there is a thick film of lubricant between the sliding surfaces. A little consideration will show that when the bearing is supplied with sufficient lubricant, a pressure is build up in the clearance space when the runner is rotating. The load can be supported by this fluid pressure without any actual contact between the sliding surfaces. The load carrying ability of a hydrodynamic bearing arises simply because a viscous fluid resists being pushed around. Under the proper conditions, this resistance to motion will develop a pressure distribution in the lubricant film that can support a useful load. The load supporting pressure in hydrodynamic bearings arises from either

1. The flow of a viscous fluid in a converging channel (known as wedge film lubrication), or
2. The resistance of a viscous fluid to being squeezed out from between approaching surfaces (known as squeeze film lubrication).

3.1 Assumptions in Hydrodynamic Lubricated Bearings

The following are the basic assumptions used in the theory of hydrodynamic lubricated bearings:

1. The lubricant obeys Newton's law of viscous flow.
2. The pressure is assumed to be constant throughout the film thickness.
3. The lubricant is assumed to be incompressible.
4. The viscosity is assumed to be constant throughout the film.
5. The flow is one dimensional, i.e. the side leakage is neglected.

Unlike rolling bearings which have a limited lifespan, principally due to their fatigue wear through the occurrence of high point loads at the contact between running elements and raceways, sliding bearings have, at least in theory, an indefinite operational lifespan. As long as an oil film of sufficient thickness is maintained and contamination is avoided, the bearing will continue to do its job indefinitely. However, more and more onerous demands are being placed on such bearings and their associated methods of lubrication in order to maximise performance in terms of efficiency and load carrying capacity. Examples are bearing of electrical generators and turbines. Sliding bearings are vulnerable to damage during rapid changes in operating parameters e.g. during the start-up process. During running, the faces of the bearing pads are separated from the shaft / collar by a thin oil film which provides a buffer in between the two surfaces (hydrodynamic lubrication). While preventing contact between the surfaces, this buffer also provides a means of cooling. However, when the machinery is stationary this film disappears and contact between the surfaces occurs. Therefore, at start-up, friction between the surfaces is inevitable until an adequate film is build up. This makes the bearing susceptible to surface damage. The use of a facing (surface coating) can help to limit this susceptibility.

The operating principle involved can be illustrated by considering a flat surface sliding over a tapered land. Motion of flat surface or thrust runner draws fluid such as lubricating oil into wedge shaped zone over the tapered land. Pumping into zone of reducing downstream clearance by shearing action of runner then pressurizes the oil. The change in separation *h* adjusts the inflow and outflow to provide the balance of integrated pressure over the bearing area with applied load. A group of tapered land thrust pads arranged with oil distribution grooves in annular configuration to form a complete thrust bearing.

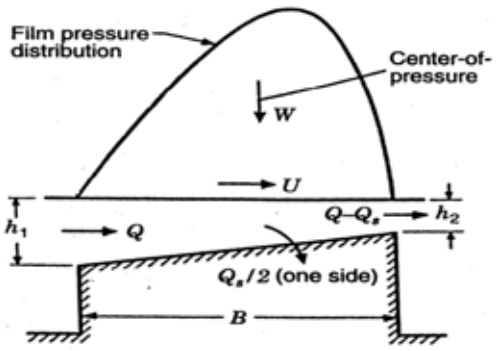


Fig 1: A Flat Surface Sliding Over a Tapered Land
[Applied Tribology- Bearing Design and Lubrication]

IV. THRUST BEARING TYPES

Six common types of thrust bearing are shown in Table 1. The first four are hydrodynamic, with their oil film pressure generated by internal pumping action. Hydrostatic bearing uses an external oil pump to supply the pressurised supporting film. Since parallel planes do not provide pumping action, Flat land bearings depend

upon thermal expansion of oil, thermal warping, and irregularities of bearing surfaces, and possibly other effects. Characteristic application practices of these various types are as follows:

Typical unit load and sizes for each type are listed in Table 1. For the typical Babbitt surface used in most machinery thrust bearings, normal upper design load limits are commonly set in the range 250 - 500 Psi to allow for uncertainties and load transients. Failure loads in tests are usually in the range 1200 - 1500 psi. At operating speeds, these failure loads will commonly involve a peak film pressure of two to three times this normal loading. The bearing Babbitt will then flow when local oil film pressure reaches the Babbitt yield strength -as temperature rises to 250-300° F range. At very low speeds, Babbitt wear becomes a limiting factor when overall film thickness drops to less than 3-10 times overall oil film thickness drops to less than 3-10 times the nominal surface roughness of mating runner.

Tapered land bearings provide reliable, compact design for variety of midsize to large, high speed machines such as turbines compressors and pumps. Flat land extending about 10-20 % of the circumference at trailing edge of each segment is commonly included for higher capacity and to minimize wear during starting, stopping, and at low speeds. Because the operation of tapered land bearing is sensitive to load, speed, and lubricant viscosity, this bearing type is commonly designed to match rated operating conditions of specific machines.

Pivoted pad thrust bearings are being used more frequently in turbines, compressors, pumps, and marine drives in much the same general size and load range as the tapered land designs. Each of the 3-10 or more pads in the bearing is commonly supported on a central pivot, which leaves it free to adjust to form nearly optimum oil wedge for supporting high loads even with widely varying speeds and lubricants and both directions of rotations.

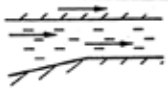
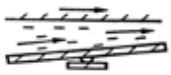
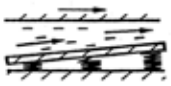
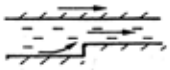
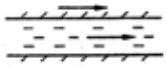
Recent modifications for increasing the load capacity, lowering the temperature and lowering the power loss include offsetting the pivots to 60-65 % beyond the leading edge of the pad, replacing steel with copper for backing of the Babbitt bearing material to give peak surface temperature, and using non-flooded lubrication to minimize parasitic power loss.

Spring or other flexible supports for the thrust segments are used in some of the largest thrust bearings carrying millions of pounds of thrust. This flexible mounting avoids high contact stresses imposed by loading individual pivots.

Step bearing provide a simple design for smaller bearings. With the use of coined or etched step, they are well suited to mass production for small bearings and thrust washers for use with low viscosity fluids such as water, gasoline and solvents. Step height should be small with the same order of thickness as the minimum film thickness for optimum load capacity, yet large enough to allow for some wear.

Flat land bearings will carry only 10-20 % of the load of other thrust bearing types, because flat parallel surfaces do not provide pumping action needed to build oil film pressure in a converging wedge shaped clearance. Instead, flat land bearing relies on thermal expansion of oil and warping of bearing material by heating from the passing oil film.

TABLE 1. Types of Thrust bearings [Applied Tribology- Bearing Design and Lubrication]

Type		O.D (in.)	Unit Load (psi)
Taper		2–35	150–400
Tilt pad		4–120	250–700
Spring support		50–120	350–700
Step		0.5–10	100–300
Flat		0.5–20	20–100
Hydrostatic		3–50	500–3000

V. TILTING PAD THRUST BEARINGS

Tilting Pad Thrust Bearings are designed to transfer high axial loads from rotating shafts with minimum power loss, while simplifying installation and maintenance. Here the load carrying surfaces are completely separated by an oil film, eliminating the risk of surface wear as long as a film of sufficient thickness is maintained. In order to attain hydrodynamic (full-film) lubrication, the pad must sit at an angle to the oil flow so that a converging "wedge" is produced (refer figure 2a). Each bearing consists of a series of pads supported in a carrier ring; each pad is free to tilt so that it creates a self-sustaining hydrodynamic film. The carrier ring may be in one piece or in halves with various location arrangements. They are used increasingly in marine drives, turbines, compressors and pumps. This flow constriction acts as a bottleneck, effectively slowing down the flow rate across the pad from the inlet edge towards the trailing edge. The gradually reducing available volume in the gap leads to a pressure build-up in the oil film giving rise to a force which "lifts" the shaft. (Refer figure 2b). Another contributory effect is the viscous flow resistance which prevents the oil from running out of the gap instantaneously as the pressure increases.

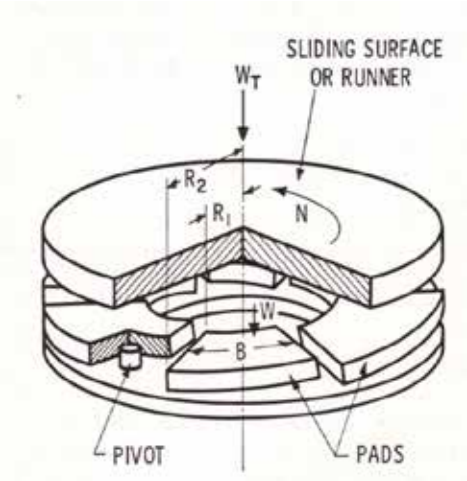


Fig.2 a) A cut-away of a tilting pad

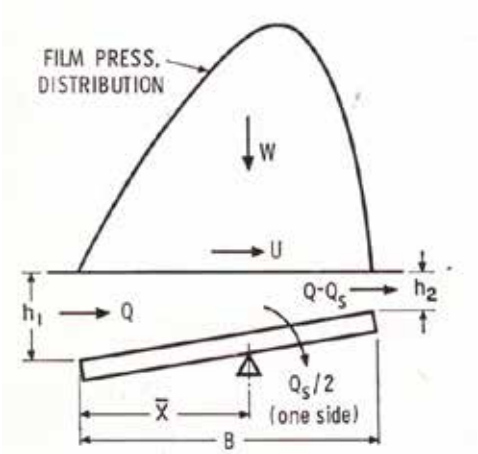


Fig.2 b) Pressure distribution within the thrust bearing and runner arrangement bearing

5.1 Research and Development on The Tilting Pad Thrust Bearing

In order to keep a machine workable for long periods, friction and wear of its parts must be kept low. It was in the 1880s when OIL FILM Lubrication was first observed and investigated during the experimental work of Beauchamp Tower with theoretical contributions from Osborn Reynolds.

The pivot pad bearing was invented by Anthony G. M. Michell in 1905 and independently by Albert Kingsbury in 1910 in a slightly different version. A G M Michell followed up, and made an important extension to, this initial work when he developed the mathematical basis for his revolutionary breakthrough in applying oil film lubrication to flat thrust faces.

In 1905 Michell patented a type of bearing in which the load was carried upon the oil films generated by a series of pivoting white metal faced pads. The principle was applied to both thrust and journal bearings, and is now universally known as the MICHELL BEARING.

VI. THE MICHELL PRINCIPLE

There are two elements in a Michell Thrust Bearing- the rotating thrust collar and the pivoting thrust pads. These two elements never come in contact while the bearing is in operation; being forcibly separated and kept apart by tapered oil films, self generated from the normal oil supply. Figure 2b, illustrates how these indestructible pressure oil films are generated and maintained between the working surfaces of the thrust pads and collar.

It is an important basic fact that the tapered pressure oil film or wedge of lubricant is self generated by the motion of the thrust collar and is not dependent on any extraneous pressure from an oil pump. All Michell thrust pads are designed and proportioned so that they tilt and generate a thick oil film to carry the thrust load. Figure 3, shows an example of pressure distribution and typical oil flow lines across the face of a Michell thrust pad. With the working faces kept apart in this simple and well ordered manner, there is no metallic contact, no metallic friction, no wear and no renewal of parts – provided of course good uncontaminated oil is always present in sufficient volume at the thrust bearing.

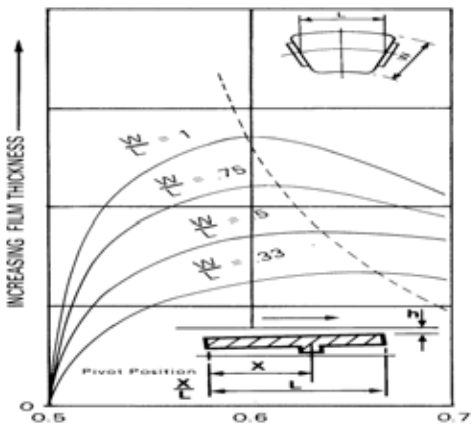
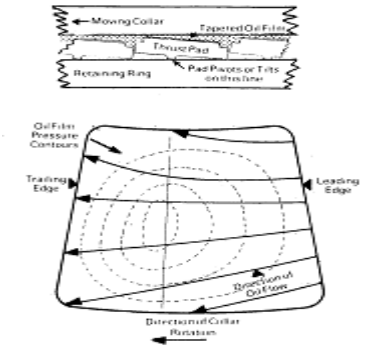


Fig. 3 Pressure Distribution and Oil Flow Lines Across

The white metal is used on the faces of the thrust pad because, white metal has the ability to absorb or embed the minute particles of grit and foreign matter which occasionally find their way into lubricating oils of even the

best kept systems. In addition to this it is the most suitable facing material to combat the boundary (partial lubrication) condition which prevails on starting and stopping.



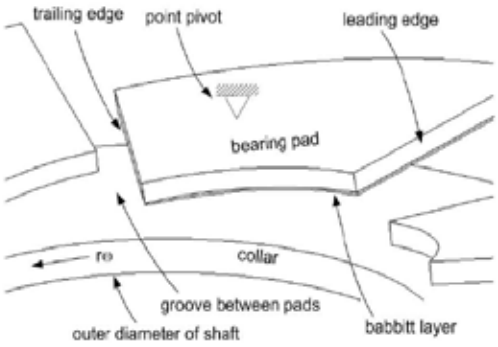


Fig. 4 Pivoted pad bearings **Fig. 5 Illustration of tilting pad bearing and terminology**

Tilting-pad bearings have the great advantage over fixed incline bearings that the pad convergence ratio $K = \frac{h_{le}}{h_{te}} - 1$ is a function of the position of the pivot only, where h_{le}, h_{te} are the oil film thickness at the leading edge and trailing edge respectively. K is independent of the operating conditions (when thermal effects and side leakage are negligible). The load carrying capacity depends strongly on K and fixed incline bearings therefore do not work well under varying operating conditions. This problem was solved by the introduction of the pivot-pad bearing. A schematic illustration of a tilting-pad thrust bearing is seen in figure 5.

Michell's construction was based on a line pivot not allowing for radial pivoting. Kingsbury used a spherical pivot, which allows the bearing-pad to tilt in all directions to compensate for misalignment between the pad and the rotor. Due to this additional advantage of Kingsbury's design the spherically pivoted bearing is in more widespread used.

The present day bearing designs are very similar to the original design. In figure 6, some examples of modern tilting-pad thrust bearings are shown. To enhance the performance some modifications of the design have been introduced over the years. Leveling systems have been introduced to ensure equal loads on all pads. In large bearings crowning of the pads due to thermal gradients between the oil film side and the backside of the pads may constitute a problem due to a negative influence on the oil film thickness distribution. In order to reduce thermal crowning circular supports, internal cooling of the pads or sandwich constructions has been introduced by bearing designers.

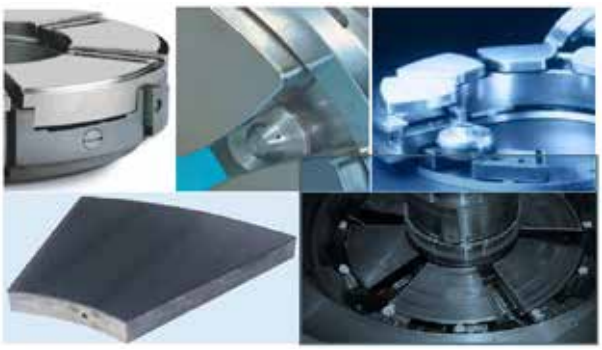


Fig. 6 Thrust bearings with different features: Leading edge grooves (top left), spray lubrication (top middle), load equalization (top right), PEEK coated pad (bottom left); oil injection pockets (bottom right).

Other designers have eliminated the pivot and positioned the pad on a bed of springs allowing for a thinner pad in which the thermal deflection is opposed by pressure bending induced by the springs. Traditionally, bearings are operated in an oil bath under fully flooded conditions. In slow speed bearings movement of the oil in the oil bath does not induce a large energy loss. In high-speed bearings however the churning loss may constitute a significant part of the total friction loss. In such bearings oil is often directly sprayed onto the collar in the groove between the pads or supplied through leading edge grooves. In large applications starting up a loaded rotor from zero velocity causes high temperatures to develop due to dry friction and the white metal surface may melt. To avoid this, hydrostatic jacking is often used. In recent years attention has turned to using polymer materials such as Polyetheretherketones (PEEK) as coating materials instead of white metal because of their low friction coefficients against steel. Hydrostatic jacking may then be avoided.

VII. CONCLUSION

This paper focus on importance of bearing and details about the types of bearing. We have studied mainly four types of bearing as they are having unique characteristics and applications in mechanical field. Thrust bearing is not in common use, but it is very useful mainly in heavy duty applications. Michell principle shows the tilting fundamentals of thrust bearing which will then leads to proper pressure and lubrication wedge distribution.

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THE EFFECT OF JET GROUTING ON THE BEHAVIOR OF STRIP FOOTING ADJACENT TO SLOPE CREST

Ahmed M. Tuhami[1], Ahmed A. Mohamed[2].

[1] *Associate Professor of Soil Mechanics and Foundations, Civil Eng. Dept. Bany Suafe University, Egypt, currently seconded to Umm Alqura university, (Saudia Arabia)*

[2]*AssistantProfessor of Soil Mechanics and Foundations, Civil Eng. Dept. AL-Azhar University, Qena, (Egypt)*

ABSTRACT

This paper studies the behavior of strip footing adjacent to slope crest and the effect of jet grouting under the footing. This problem is investigated numerically in the present study. Two dimensional plane strain program PLAXIS is used in this study. 15 nodes triangular element is used to idealize soil with Hardening soil model. Five nodes isoperimetric beam element is used to idealize stripe footing. Interface element is used to represent the contact between beam element and soil. Two parameters were studied, the first is the foundation depth and the second is the Stripe footing distance from the slope crest. Settlement and horizontal displacement of strip footing were obtained and studied from the analyzed finite element model results. The reduction influence of jet groutingon footing displacement were studied and investigated. The results indicate that the inclusion of jet grouting under strip footing adjacent to slope crest has significant effect in improving the response of the strip footing and the slope.

Keywords: Strip footing, Jet grouting, Slope, PLAXIS, Relative distance.

I. INTRODUCTION

The bearing capacity of the foundation is a primary concern in the field of foundation engineering. The foundation should transfer theself weight of the structure and the applied loads to the soil safely and economically. Quite often, structures are built on or near a slope. This is due to land limitation, such as for bridges or for architectural purposes. The ultimate bearing capacity of the foundations is significantly affected by the presence of the slope. Design of foundations under these conditions is Complex due to expected deformation and rotation of nearby slope .In these cases design requirements stipulate that in additional for the foundations to transfer the load safely to the underlain soil strata but also the stability of the slope after incorporating the foundations load must remain intact. Occasionally engineers are required to determine the location and depth of foundations to be built on or near slope. Design of safe foundation in this case inquires determining the minimum distance and foundation depth as a function of slope geotechnical conditions.

There are many situations where shallow footings are constructed on sloping surfaces or adjacent to a slope crest such as footings for bridge abutments on sloping embankments. When a footing is located on a sloping ground, not only the bearing capacity of the soil may be significantly reduced, but also the potential failure of the slope itself significantly increased depending on the location of the footing with respect to the slope. Therefore, over

years, the subject of stabilizing earth slope has become one of the most interesting areas for scientific research and attracted a great deal of attention.

Typical methods of enhancing slope stabilityinclude modifying the slope surface geometry, chemical grouting, using soil reinforcement, or installing continuous or discrete retaining structures such as diaphragm walls, sheet pile walls or piles, (M. El Sawwaf 2009).

Injection methods are attractive because they can be implemented at relatively low cost. Their drawback is that it is difficult to quantify the beneficial effects. In addition, when fluids are injected, the short-term effect may be to make the slope less stable. The beneficial effects may be achieved only later, when the injected material has hardened or has reacted with the soil to alter its properties. (J. M. Duncan and S. G. Wright 2005)

Lime piles are drilled holes filled with lime. Lime slurry piles are drilled holes filled with slurry of lime and water. Rogers and Glendinning (1993, 1994, and 1997) reviewed the use of lime piles and lime slurry piles to stabilize slopes, and the mechanisms through which they improve soil strength and stability.

Handy and Williams (1967) described the use of quicklime placed in drilled holes to stabilize a landslide in DesMoines, Iowa. Six-inch-diameter holes were drilledthrough a compacted silty clay fill, down to the surfaceof the underlying shale, where the fill was sliding onthe top of the shale. About 50 lb of quicklime wasplaced in each hole, filling the bottom 3 ft. Water wasthen added to hydrate the lime, and the holes werebackfilled to the surface with soil. Holes were drilled5 ft apart, stabilizing an area 200 ft by 125 ft usingabout 20 tons of quicklime. Physical and chemical testson the treated soil showed that the lime was reactingwith and strengthening the silty clay fill. Movement ofthe slide essentially stopped within three months aftertreatment, while movements continued in adjacent untreatedareas.

Stabilizing landslides by injecting cement grout hasbeen used extensively on both American (Smith andPeck, 1955) and British railroads (Purbrick and Ayres,1956; Ayres, 1959, 1961, 1985). Typical practice involvesdriving grout points about 5 ft apart in rowsparallel to the track, the rows being about 15 ft apart.The tips of the grout points are driven about 3 ft belowthe estimated depth of the rupture surface, and about50 ft^3 of grout is injected through each point. Quitehigh grouting pressures are used for the shallow depthsinvolved: For grouting only 15 ft beneath the surface, a grouting pressure of 75 psi might be used for injectionof the first 10 ft3, subsequently dropping to 20 psi.

Results of laboratory model tests and numerical study on the behavior of a strip footing withstructural skirts adjacent to a sand slope are presented and investigated by (W. R. Azzam and A. Farouk (2010))

S.V. Anil Kumarand K. Ilamparuthi (2009) concluded that load-settlement behavior and bearing capacity can be improved by inclusion of geosynthetic reinforcement underthe footing. Further the bearing capacity decreases with increase in slope angle and decrease in edge distance both inreinforced and unreinforced slopes.

II. OBJECTIVES

The main objective of the present studyis to investigate different aspects of the behavior of slopes in soil and the response of structures located near these slopes. The main objectives for this research are:-

i. Establishing an analytical model to represent realistic behavior for the slope and theadjacent strip footing.

ii. Studying the effect of the parameters affecting on the behavior of the chosen modelsuch as distance between the building and slope crest and building foundation depth.

iii. Studying the effect of jet grouting on the behavior of strip footing adjacent to slope crest.

III. NUMERICAL MODELING AND SELECTION OF PARAMETERS

Soil code Finite Element Program Plaxis 7.2 was used in numerical modeling. Plaxis program was further applied to analysis different investigated parameters using prototype dimensions.

3.1 Material Model of Sandy Soil

In order to make realistic predictions of the stability and deformations of slope and adjacent building, the Hardening soil model in PLAXIS program was used for sand idealization. This model adopted to characterize the behavior of slope and adjacent strip footing system and material properties are presented herein.The sand is modeled by 15-node triangular element in the analysis as an elastic perfectly plastic hardening model. The parameters of medium sand are presented in Table (1).

Parameter	Name	Value	Unit
Soil dry unit weight	γ_d	17	kN/m^3
Wet soil unit weight	γ_{wet}	20	kN/m^3
Secant stiffness in standard drained triaxial test	E^{ref}_{50}	14925	kN/m^2
Tangent stiffness for primary oedometer loading	E^{ref}_{oed}	10447	kN/m^2
Unloading / reloading stiffness	E^{ref}_{ur}	44775	kN/m^2
Poisson's ratiofor unloading-reloading	υ_{ur}	0.25	-
Cohesion	c	1	kN/m^2
Friction angle	φ	36	degree
Dilatancy angle	ψ	6	degree
Interface reduction factor	R	0.8	-
Power for stress-level dependency of stiffness	m	0.5	-
Reference stress for stiffnesses	p^{ref}	100	kN/m^2

3.2 Jet Grouting

This method of stabilization is best worked for loose sandy soil. Each of thosetechniques is applied in different situations for the same purpose.Compacting grouting is successfully applied to densify a thick loose sand layer in urbanenvironment. This method densifies loose sandy soil and mitigates liquefaction of soil byinjection in the soil without entering in its pores. Permeation grouting is very effective inincreasing the resistance of uncompacted soils against liquefaction by injection in the soil poreswithout changing its physical structure. Jet grouting is suitable method to underpinning ofexisting foundation to improve the strength of liquefiable soil but it neither stiffen the ground norreduce shear stresses of soil. Jet columns provide bearing support and reduce settlement ifliquefaction is limited to a specific zone. (SanazSayehvand and BehzadKalantari(2012))

Jet grout columns can be constructed in all soils; however the effective radius and strength depends on the properties of thesoil and the jet grouting parameters used. In granular soils jet grout columns can have a strength of about 10 to 15 MPa ormore; however the strength of jet grouted columns in clay can be quite less and as low as 1 MPa. Jet grout strength isprimarily determined by the soil type; however the amounts of cement used per unit volume and the water-cement ratio also have an effect. Typical water-cement grouts have a water-cement ratio in the range of about 0.6 to 1.2 by weight.For single fluid system jet grouted columns, typically diameters are on the order of 0.4 to 0.6 m in cohesive soils and up toabout 1.2 m in granular materials. In two-fluid system column diameters are on the order of 0.8 to 1.2 m in cohesive soilsand up to about 1.8 m in granular soils.

Implementation of the triple fluid system allows the construction of larger diametercolumns whereas in cohesive and granular soils the diameters can be respectively up to 1.5 m and 3.6 m. (Hamidi, et.al, (2009))

Marcelo et. Al, (2007) concluded that the unconfined compressive strength of the jet-grouted soil rangedfrom 4.6 MPa to 9.7 MPa after 28 days to Grout W/C=1.25 by weight.

Alp Gokalp and RasinDuzceer (2001) Concluded that The unconfined compressive strength of the jet grouted soil ranged from 3.6 to 20.4 Mpa after 21 days to Grout W/C=1by weight.

Z.-F. Wang (2012) Mentioned that Engineering experience in Seoul indicates that the unconfined compressive strength of the solidified columns can reach to 5.0–6.0 MPa after 28 days of curing to Grout W/C=1by weight.

Table(2) provides a general summary of operational parameters and grouted soil strengths. Where F1, F2 and F3 are one fluid system, two fluid system and three fluid system respectively.(Xanthakos, et.al. (1994))

Jetting Parameter		F1	F2	F3
Injection pressure				
Water jet	(MPa)	PW*	PW	30–55
Grout jet	(MPa)	30–55	30–55	1–4
Compressed air	(MPa)	Not used	0.7–1.7	0.7–1.7
Flow rates				
Water jet	(liters/min)	PW	PW	70–100
Grout jet	(liters/min)	60–150	100–150	150–250
Compressed air	(m^3/min)	Not used	1–3	1–3
Nozzle sizes				
Water jet	(mm)	PW	PW	1.8–2.6
Grout jet	(mm)	1.8–3.0	2.4–3.4	3.5–6
Number of water jets		PW	PW	1–2
Number of grout jets		2–6	1–2	1
Cement grout W–C ratio			0.80–1 to 2–1	
Cement consumption	(kg/m)	200–500	300–1000	500–2000
	(kg/m^3)	400–1000	150–550	150–650
Rod rotation speed	(rpm)	10–30	10–30	3–8
Lifting speed	(min/m)	3–8	3–10	10–25
Column diameter:				
Coarse-grained soil	(m)	0.5–1	1–2	1.5–3
Fine-grained soil	(m)	0.4–0.8	1–1.5	1–2
Soilcrete strength				
Sandy soil	(MPa)	10–30	7.5–15	10–20
Clayey soil	(MPa)	1.5–10	1.5–5	1.5–7.5

In the finite element model, Jet Grouting columns were represented by a wall with a thickness based on equivalent axial stiffness (Hamidi et al, 2009)

In this study the used jet grouting material was as which used by F. Tschuchnigg, H. F. Schweiger (2008). The diameter d has been taken as the true diameter and the stiffnesses of the piles are converted into equivalent stiffnesses according to their spacings (Table 3). The Mohr-Coulomb model is used to describe the behavior of the jet grouted columns. The interaction between jet grouted columns and the subsoil can be assumed as very rough hence no interface elements are defined between columns and soil.

Table (3). Properties of the jet grout piles for the 2D model

Spacing (m)	type	γ_b (kN/m^3)	γ_{sat} (kN/m^3)	υ	E_{ref}(kN/m^2)	C_{ref}(kN/m^2)	φ (°)
2.00	drained	21.5	21.5	0.15	5000000	1350	32.5

3.3 Strip Footing

Strip footing can be simulated by beam element. This line element has bending stiffness, EI, and axial stiffness, EA. Where:

E: modulus of elasticity for concrete $= 4400\sqrt{F_{cu}}$ (N/mm^2)

A: area of cross section

I: moment of inertia

F_{cu}: characteristic strength (25N/mm^2)

The footing is loaded with distributed load 100 kN/m^2, which is transferred to soil. The properties of footing are given in Table (4).

Table (4) Material Properties For The Strip Footing

Parameter	Name	Value	Unit
Axial stiffness	EA	3.811E+07	kN/m
Flexural rigidity	EI	3.175E+06	kN.m^2/m
Equivalent thickness	d	1.00	m
Weight	w	25.00	kN/m/m
Poisson's ratio	υ	0.2	-

IV. FINITE ELEMENT MODEL

4.1 Finite Element Mesh

Fig. (1). presents the configuration of the problem under investigation and the corresponding variables that were assigned in the numerical model, H represents the vertical length of slope. L represents the horizontal length of slope.B represents the width of the footing and X represents the distance of the footing from the edge of slope. Y represents the depth of the depth of jet grouting underneath footing. Note that the distance X was measured, according to Meyerhof s theory, between slope crest and the footing edge which face to the side of slope. D represents the embedded depth of the footing. The tests were conducted with different value ofD and X in order to evaluate the variation of the settlement due to slope effect. The finite element mesh is generated automatically by the program as a very fine mesh to be more accurate in representation of slope behavior, as shown in Fig. (2)

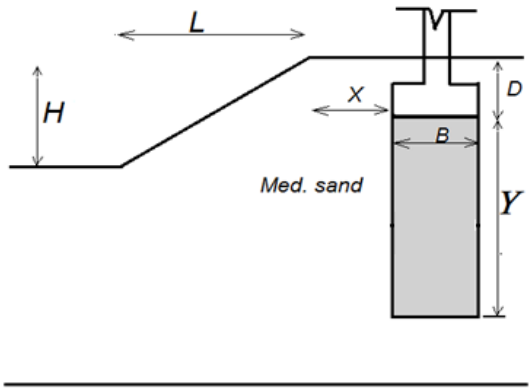

Fig. (1) Model of slope, adjacent area and strip footing

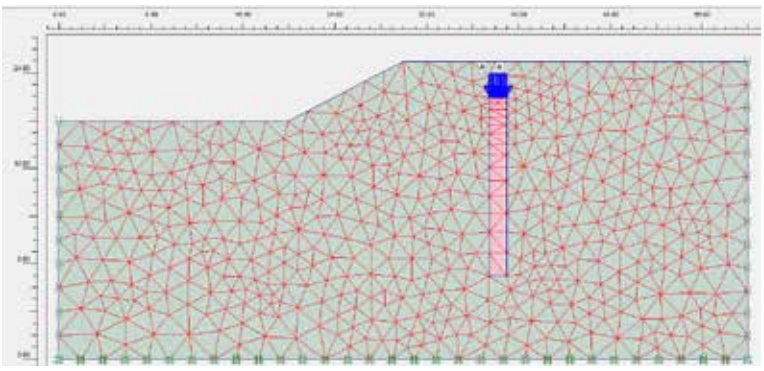

Fig. (2) Finite Element Mesh For The Model Of Slope And Adjacent Area

4.2 Analysis Procedure

The elastic perfectly plastic finite element analysis involves a number of iterations. Four foundation depths models with R_d=D/H equal to be 0.0, 0.2, 0.4 and 0.6 were considered. For each foundation depth model, the footing was placed in different location in horizontal direction. This location was based on the R_x=X/B ratio, which was assigned to be equal to 0, 1, 2, 3, 4 and 5. The variation of the settlement with respect to the location of footing in horizontal direction can be observed with and without jet grouting underneath the footing. Table (5) presents the studied cases.

Table (5) Analysis Cases Used In The Numerical Study.

D/H	X/B	In case of
	0	Before jet grouting
0	1	With jet grouting Y/B =2
0.2	2	With jet grouting Y/B =3
0.4	3	With jet grouting Y/B =5
0.6	4	With jet grouting Y/B =10
	5	

V. ANALYSIS AND RESULTS

The effect of studied parameters on settlement values of strip footing may be presented as follows:

5.1. Deformation of Strip Footingbefore Jet Grouting Process

5.1.1 The Settlement of The Strip Footing

Figures (3) shows the relationship between settlement of strip foundation and (R_x) for R_d = 0.0, 0.2, 0.4, and 0.6. The maximum settlement was found where the building is nearest to the slope crest. When the values of (R_x) and (R_d) were increased, a corresponding decrease in the settlement of strip footing was recorded. At R_d = 0 the maximum settlement at R_x = 0 has a value of 110 mm. Differential settlement can be observed which decrease at R_x = 1. It can be observed that the settlement decrease by increasing the depth of foundation. At $R_x \geq$ 2no considerable difference was noticed in the values of foundation settlement for all cases.

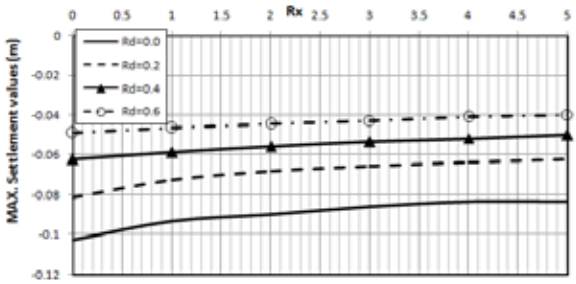

Fig. (3): Variation of The Maximum Foundation Settlement Values For Different Values Of $R_x$and R_d Before Jet Grouting.

5.1.2 The Horizontal Displacement of The Strip Foundation

Figure (4) shows the relationship between horizontal displacement of strip foundation and (R_x) for different values of R_d. The maximum horizontal displacement was found where the building is nearest to the excavation. When the values of (R_x) and (R_d) were increased, a corresponding decrease in the horizontal displacement of strip footing was recorded. At R_d = 0 the maximum horizontal displacement at R_x = 0 has a value of 35 mm. At $R_x \geq$ 3no considerable difference was noticed in the values of foundation horizontal displacement for all cases.

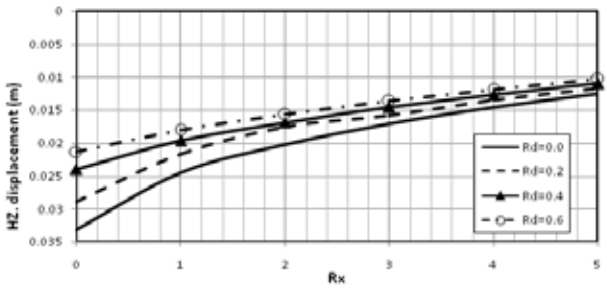

Fig. (4): Variation of The Foundation Horizontal Displacement For Different Values Of R_x andR_d before jet grouting.

5.2. Deformation of Strip Footingafter Jet Grouting Process

5.2.1 Influence of Jet Grouting Depth On Footing Settlement

Figures (5, 6, 7, and 8) showInfluence of jet grouting depth on maximum values of footing settlementfor different values of R_x and R_d. Jet grouting provides an opportunity to significantly decrease footing settlement. When the values of (Y/B) were increased, a corresponding decrease in the maximum settlement values of strip footing was recorded in the same case of R_x and R_d. The settlement values in all cases exhibited a decrease with the increase in the Y/B values. As depicted in Figures (5, 6, 7, and 8), there is approximately 45%, 55%, 68% and 86% decrease in maximum footing settlement values due to the values of Y/B are 2, 3, 5 and 10, respectively for all cases.

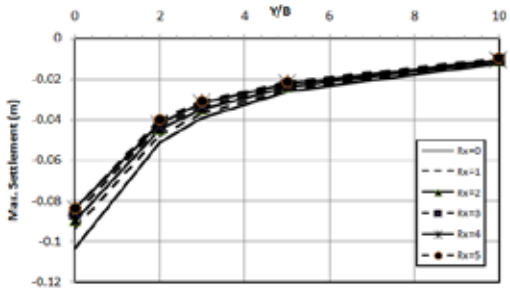

Fig. (5): Influence of jet groutingdepth on max. Footing settlementfor different values of R_x and R_d=0m.

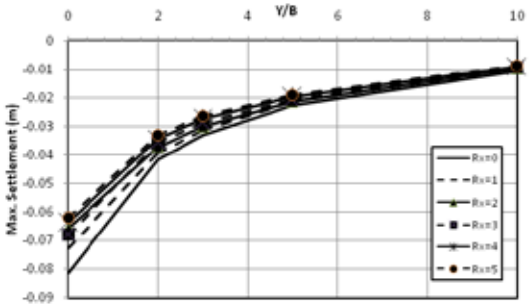

Fig. (6): Influence of jet grouting depth on max. footing settlementfor different values of R_x and R_d= 0.2m.

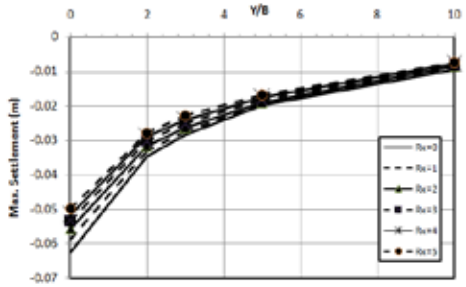

Fig. (7): Influence of jet grouting depth on max. footing settlementfor different values of R_x and R_d= 0.4m.

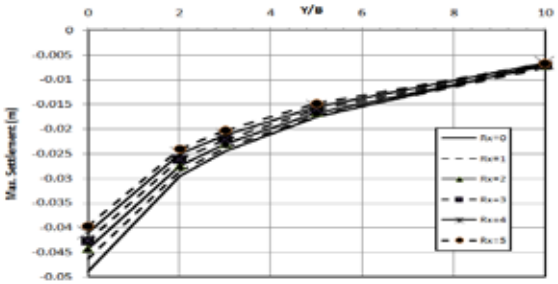

Fig. (8): Influence of jet grouting depth on max. Footing settlementfor different values of R_x and R_d= 0.6m.

The reduction in maximum settlement values for strip footing adjacent to slope crest due to jet grouting process for medium sand may be expressed as follows:

$$\frac{S_f - S_i}{S_i}\% = 4.83\frac{Y}{B} - 7.52 \times 10^{-2}\frac{X}{B} - 16\frac{D}{H} + 44.3$$

Where:

S_f = settlement after jet grouting

S_i = settlement befor jet grouting

5.2.2 Influence of Jet Grouting Depth On Footing Horizontal Displacement

Figures (9, 10, 11, and 12) show Influence of jet grouting depth on footing Horizontal displacementvalues for different values of R_x and R_d. When the values of (Y/B) were increased, a corresponding decrease in Horizontal displacementvaluesof strip footing was recorded in the same case of R_x and R_d. The Horizontal displacement of strip footing values in all cases exhibited a decrease with the increase in the Y/B values. As depicted in Figures (9, 10, 11, and 12), there is approximately 4%, 6%%, 8% and 12% decrease in Horizontal displacementvalues of strip footing due to the values of Y/B are 2, 3, 5 and 10, respectively for the case of R_x=0.The Influenceof jet grouting depth on the footing horizontal displacement is decrease by increasing of R_x and R_d values.

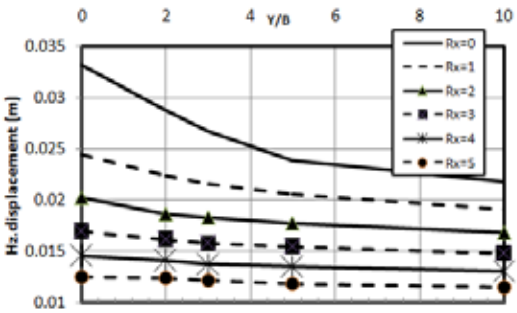

Fig. (9): Influence of jet grouting depth on f ooting Hz. displacement for different values of R_x and R_d=0.0m.

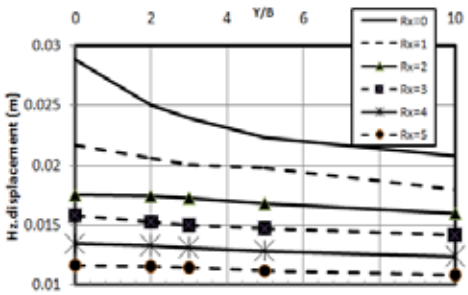

Fig. (10): Influence of jet grouting depth on footing Hz. displacement for different values of R_x and R_d= 0.2m.

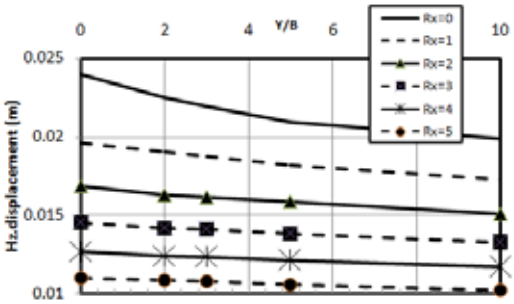

Fig. (11): Influence of jet grouting depth on footing Hz. displacement for different values of R_x and R_d= 0.4m.

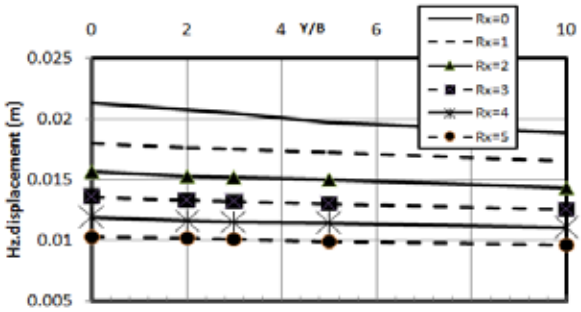

Fig. (12): Influence of jet grouting depth on footing Hz. displacement for different values of R_x and R_d= 0.6m.

VI. CONCLUSIONS

Strip footing adjacent to slope crest was studied by PLAXIS program in this research. The settlement and horizontal displacement of footing were studied and investigated. Two main parameters were studied, the first is

the relativedepth of foundation, Rd= D/H and the second is the relative distance, $R_x = X/B$, X is the building distance. The reduction influence of jet groutingon footing displacement were studied and investigated. The jet grouting height,Y values are 2B, 3B, 5B and 10B.The following conclusions can be drawn from the obtained results:

- The maximum settlement was found where the footing is nearest to the slope crest. When the values of (R_x) and (R_d) were increased, a corresponding decrease in the settlement of strip footing was recorded.
- The maximum horizontal displacement of footing was found where the footing is nearest to the slope crest. When the values of (R_x) and (R_d) were increased, a corresponding decrease in the settlement of strip footing was recorded.
- Jet grouting provides an opportunity to significantly decrease footing settlement. When the values of (Y/B) were increased, a corresponding decrease in the maximum settlement values of strip footing was recorded in the same case of R_x and R_d.
- The settlement is approximately 45%, 55%, 68% and86%decrease in maximum footing settlement values due to the values of Y/B equal to 2, 3, 5 and 10, respectively for all cases of R_x and R_d.
- When the values of (Y/B) were increased, a corresponding decrease in Horizontal displacementvalues of strip footing was recorded in the same case of R_x and R_d.

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INTELLIGENT SECURITY SYSTEM FOR GIRLS IN HOSTEL

Amol Sapkal[1], Samiksha U.Katait[2], Puja S. Ingole[3], Neha Dumre[4], Preeti Ughade[5]

[1]Assistant Professor, [2,3,4,5] Student, Department of Electronics & Telecommunication, DMIETR, Wardha, (India)

ABSTRACT

Security in the organization is one of the most persistent problems that organization needs to address. Now-a-days security is a prime concern in every human beings life. So, this proposed system is "Intelligent security system for girls in hostel" provides security. This proposed work enlightens upon the invention as well as technology advancement in the field of security. In this proposed work the concept of finger print authentication will be used as password. So, whenever the girl wants to leave the hostel, she can enter her out time and destination place and she can carry security module with her. When the girl is in danger that time the girl will press the key on the security module and one message will sent to the wardens mobile, also the message will send to the parents mobile number along with location of that girl . The technology used in the system is based on the finger print, GPS modem and GSM modem. This proposed work will be helpful for peoples in different organization.

Keywords: Fingerprint Authentication, GSM, GPS, Security Module.

I. INTRODUCTION

The IEEE paper "Automation of Attendance System uses RFID, Biometrics, GSM Modem with .Net Framework", it is observed that it is used to develop the wireless system to detect and maintain the attendance of student and locate the student. The proposed scheme presents the real time security managing methods that can be implemented using RFID, Biometric and Smart Messaging. Registered Staff manages their entry through their RFID card, which is verified with Biometrics. In both above paper it is observed that the RFID card is used for identification and the RFID card is used by the any person if he knows the password of that RFID card. To overcome this drawback, we use fingerprint technology, hence no one can use the other name as the every human being has different design pattern on finger. So, this is "Intelligent security system for girls in hostel" by using Fingerprint scanner. In propose system girl can get automatic permission to leave the hostel without wastage of time and warden also get whole day report of all girls in hostel.

II. SYSTEM OVERVIEW

2.1 Block Diagram of Main Module

The study of the block diagram shown in fig 2.1 is very helpful to the designer

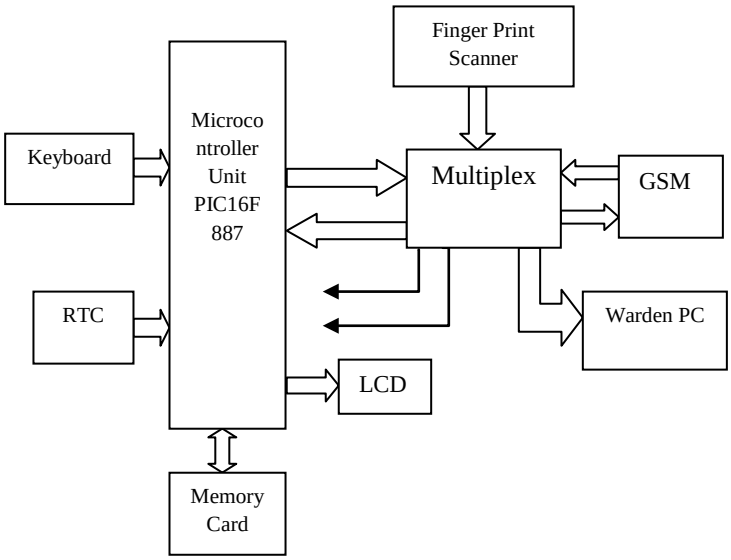

Fig 2.1 Block Diagram of Main Module

PIC Micro-Controller: Micro-controller used in the system shown in Fig 2.1 is PIC 16F887 micro-controller. It controls all the activities of the system. It stores the data of the finger prints and compares the current finger prints with the data base, checks the password, also sends the stored message to the mobile phone of the warden using GSM modem

LCD Display: The LCD display used is to show the time and date. The display used in the projects is 16*2 displays. The password enter by the girl is display on the LCD display along with the destination place which she had ente**r.**

Finger Print Scanner: You have a unique design, which represents you alone, literally at your fingerprints. A fingerprint scanner's job is to take the place of a human analyst by collecting a print sample and comparing it to other samples on record. This design unit converted into binary code which is save as data.

2.2 Block Diagram of Security Module

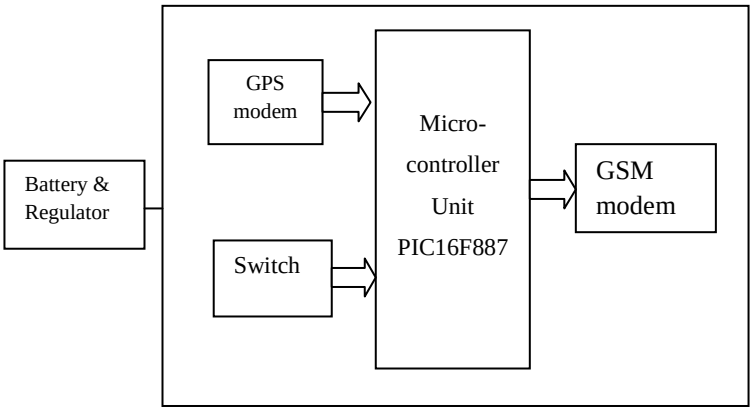

Fig 2.2 Block Diagram of Security Module

The security module in the propose system is as shown in Fig 2.2 which helps to provide security.

1. **GPS Module:** The **Global Positioning System** (**GPS**), it is a space-based satellite navigation system that provides location and time information in all weather conditions, anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites.

2. **GSM MODEM:** The GSM modem is nothing but a small mobile phone with IMEI no. and is used to sends the message to the warden's mobile phone. The stored text data is input from the microcontroller. When a GSM modem is connected to a computer, this allows the computer to use the GSM modem to communicate over the mobile network.

III. METHODOLOGY

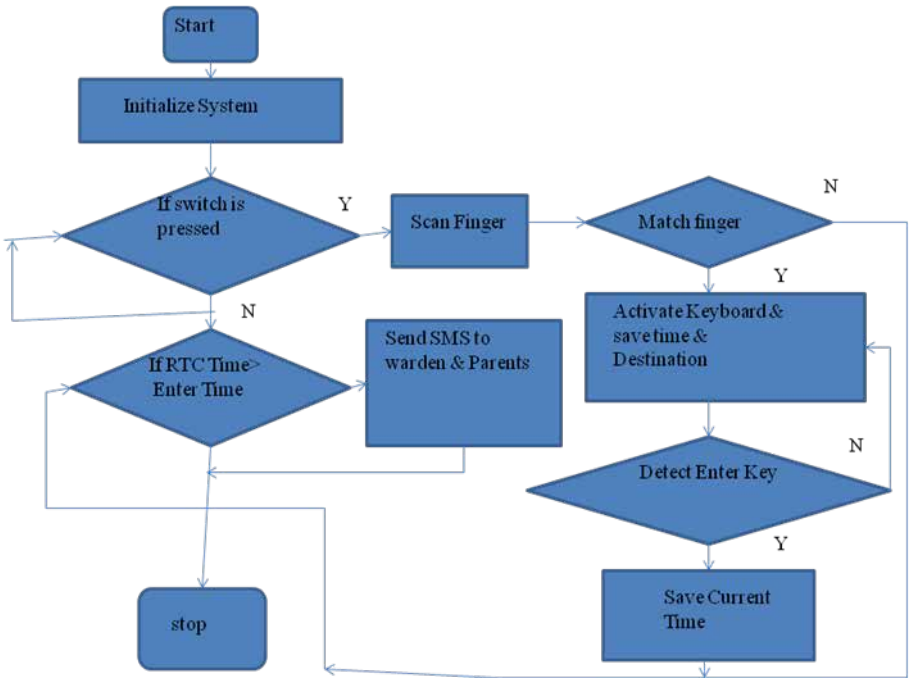

Fig 3.1 System flowchart

IV. WORKING

In proposed system when the girl wants to leave the hostel she has to give her finger print to the scanner. So no girl can utilize other name while leaving the hostel. When she has to go outside the town, then the message will conveyed to the warden via the GSM system. The warden can also get the report of girls in whole day if she wants and she can also change her mobile number. Along with this, system providing a security module which the girl can carry with her. Whenever the girl is in danger that time the girl will press the key on the security module and one message will sent to the wardens mobile, also the message will send to the parent's mobile number along with exact location of that girl. When girl leave the hostel, that out time will sent to warden and parents that the girl is leaving hostel and the place of destination and returning time also sent to them.

V. CONCLUSION

This system provides the security for the girls in the hostel and save the time. This proposed system uses the Real Time Security Management System which enables efficient and easy way of security monitoring in big

organization, real time status monitoring and smart massaging definitely make the security management more efficient and reliable. RFID card can be used for identification but it is not safe. So to overcome this drawback, we use fingerprint technology, hence no one can use the other name as the every human being has different design pattern on finger.

VI. FUTURE SCOPE

Future enhancement in the system can be the different problem which face by the students in the hostel which can be solved. Software can be made for the mobile phones and then using the mobile phones GPS (Global Positioning system) the location of the student can be find out.

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BUSINESS PROCESS MINING APPROACHES: A RELATIVE COMPARISON

Saiqa Aleem[1], Luiz Fernando Capretz[2], Faheem Ahmed[3]

[1,2]Department of Electrical & Computer Engineering, Western University, London, ON (Canada)

[3]Department of Computing science, Thompson River University, Kamloops, BC (Canada)

ABSTRACT

Recently, information systems like ERP, CRM and WFM record different business events or activities in a log named as event log. Process mining aims at extracting information from event logs to capture business process as it is being executed. Process mining is an important learning task based on captured processes. In order to be competent organizations in the business world; they have to adjust their business process along with the changing environment. Sometimes a change in the business process implies a change into the whole system. Process mining allows for the automated discovery of process models from event logs. Process mining techniques has the ability to support automatically business process (re)design. Typically, these techniques discover a concrete workflow model and all possible processes registered in a given events log. In this paper, detailed comparison among process mining methods used in the business process mining and differences in their approaches have been provided.

Keywords: Business Process Management, Data Mining, Process Mining, Software Analytics

I. INTRODUCTION

With the emerging globalization and competent environment, enterprises are required to improve their existing business processes. For that purpose, combination of data mining and machine learning techniques are introduced to workflow field, i.e., process mining [1]. Due to fast paced competitive market, it become essential that enterprise have continues and insightful feedback on how business process actually being executed within the enterprise. In short, enterprise requires a good analysis tool to get insight into its business processes. The requirement of an enterprise to know how actually processes happen in real world is a major driver behind the development and increasing use of process mining approaches.

The goal of business process mining or in short process mining is to automatic construction of process models from event log. The extracted model (e.g. in form of Petri-Net) is the explanation of observed behavior in the event logs. For mining purpose, event logs are used as a starting point. In some systems events log referred to as history, audit trails and transactional logs. It is possible to record events in such a way that each event may refer to a task or a case. The processes or cases in an event log can be looked from different perspectives [2]: (a) process perspective (How?) focuses on the control flow for example ordering of activities [3], (b) organization perspective (Who?) focuses on the performers field, i.e. how they are related and which performers are involved; and (c) the case perspective (What?) focuses on case properties to establish relation between them, e.g. characterization of cases based on path in the process, performers performance or their utilization.

The rest of the paper is organized as follows: Section 2 briefly describes about the different approaches utilized in process mining, Section 3 discusses and compares those approaches in detail and finally section 4 concludes the paper.

II. BUSINESS PROCESS MINING APPROACHES

Business process mining exploits the information recorded in events logs and portrays a family of a-posteriori analysis approach. To analyze processes in event logs process mining is a suitable technique. The proposed approaches for process mining can be distinguished in to three types [4]: discovery, conformance and extension as shown in the above Fig. 1.

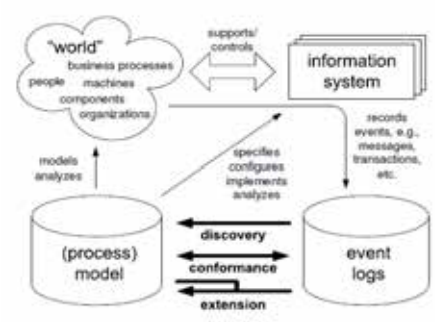

Fig: 1Three Types of Process Mining: (1) Discovery, (2) Conformance, And (3) Extension [4]

Discovery based process mining techniques extract information related to data from event log only.

Conformance based techniques verify that if actual processes in enterprise follow prescribed behaviors or rules.

Extension base techniques takes existing model as input and enhance that model based on the information extracted from event logs. There is also a-priori model.

Process mining can be described as a sub-domain of data mining. In process mining, event logs can consist of information about the attribute of cases and actual flow or route of the tasks by case. Traditional data mining approaches mine the decision rules that predicts the flow or route of a case where as process mining focuses on the mining of process model. In section III, we describe the different approaches used for business process mining.

III. APPROACHES

The research in process mining dedicated by many scholars and so far they have made lots of achievements and improvements in the field of process mining. Earliest work related to process mining investigated by Cook and wolf in the context of software engineering processes [5].

Their proposed work was not directly related to business processes discovery but they introduced the basic thoughts about process mining. Their proposed algorithm deals with noise and parallel structure [1]. Later they also worked on conformance of models that is based on concurrent processes of probability [6]. The idea of process mining in the context of workflow management was first introduced in [7]. He is the one who named the technology officially as process mining and proposed an algorithm. They stated that algorithm that computes conformal graph with complexity O ($m^{\times}n^3$). It deals with noise and parallel structure.

A meta model for process mining proposed by Dongen and Van der Aalst [8]. A new format based on XML called MXML. Their work is more programmatic and driven by concrete tools. They claimed that this framework will help researchers in implementing new process mining techniques without caring about the information

systems, the event logs generated by. For process mining, broad variety of approaches/algorithms does exists and for better understanding they are further classified as follows.

3.1 Deterministic Mining Approach

The approaches that belong to this category only produce reproducible and defined results. The α-algorithm based approaches can be classified under this category. Van der Aalst *et al.* [9] proposed α-algorithm that can mine any workflow and is represented in SWF-net i.e. sub class of Petri nets. To explain SWF-net is out of the scope of this paper. If further information is required on SWF-net refer to [9]. It was one of the first approaches to take concurrency into account (i.e., explicit causal dependencies and parallel tasks). Algorithm first analyzes the event log then establishes various dependency relations between tasks. Relations between tasks considered as casual and also describe the sequence of the tasks. Fig. 2 showed that these types of constructs cannot be mined.

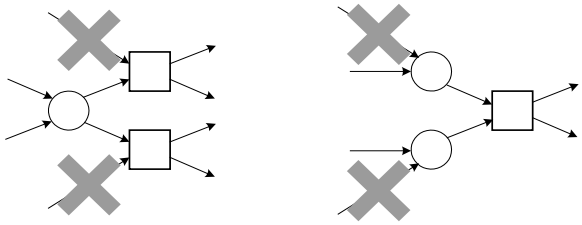

Fig. 2 Construct Cannot Be Mined In A-Algorithm [9]

3.2 Heuristic Mining Approaches

Heuristic techniques used by process mining algorithms to better deal with noise and incompleteness [9]. It involves three mining steps, first of all it constructs the dependency/frequency table (D/F-table), secondly mine the basic relations out of the D/F-table (R-table) and then finally reconstruct the WF-net out of the R-table.

van der Aalst [10] demonstrated the applicability of process mining in real-world. They used this heuristic approach to deal with problems in process mining. They reported that most of the existing systems do not focus on casual and dynamic dependencies in process and organizations. To handle that problem they used heuristic approach [9]. In order to capture organization perspective, they utilized Social Network Analysis (SNA) [11] techniques and embeds the MiSoN [2] functionality in the framework for analyzing relationships. The model is represented in terms of Petri-Nets. The process mining refers to logical structure of the process model and performance issues such as flow time. They used ProM framework (Plug-able environment) to cover the all three perspective in an organization. Five different types of plug-ins are allowed with in this framework: mining plug-in, export plug-in, import plug-in, analysis plug-in and conversion plug-in. ProM uses MXML format for process mining. To achieve a richer understanding of the processes in an organization, it is worthwhile to combine different mining perspectives as showed in this case study. Number of limitations of process mining also showed in this case study. For example, only those events were considered which are logged, privacy issues are also there.

3.3 Inductive Approach

The purpose of this approach is to acquire the business process models and their adaptation to the changing requirements by identifying the best HMMs (Hidden Markov Models) that showed the process model. Inductive approach involves two steps (i) Induction step and (ii) Transformation Step. Induction step involves creation of Stochastic Task Graph (SAG) from event log. The transformation step is responsible for the synchronization of structures of event log instances, generation of synchronized structures and generation of process model. Herbst

and Karagiannis [12] dealt with the duplicate tasks and their proposed algorithm based on inductive approach two steps. First step is induction step same as described above and in second step SAG is generated. That graph is then transformed into blocked structured model in ADONIS definition language (ADL). The developed tool is called InWoLvE that takes many parameters but it requires proper parameters to improve mining efficiency and quality. Schimm [13] proposed an approach that deals with the hierarchal structural workflow model and used inductive bias. That model deals with the splits and joins and it extract accurate model from event log. He demonstrated that method by using detailed example and also developed a tool process miner. Wainer *et al*. [14] proposed approach based on process algebra and is used to derive final model, they utilized the existing models. It is type of Extension in process mining. The main idea is to rewrite the existing models with new instances, it is complex in implementation and have high time and space complexity.

3.4 Genetic Mining Approach

Genetic algorithm [15] can be used to mine process models out of events log. First of all, it creates the initial population of workflows. For that purpose, it builds the causal Metrics that contains the relations among tasks. In second step it calculates the Fitness of each individual. The main idea of using is to benefit the individuals that can parse more frequent material in the log. To calculate the fitness, a continuous semantics parser and register problems technique utilized.

$$F(L,CM) = \frac{allParsedActivities(L,CM) - punishment}{numActivitiesLog(L)}, \text{ where}$$

$$punishment = \frac{allMissingTokens(L,CM)}{numTracesLog(L) - numTracesMissingTokens(L,CM)+1} + \frac{allExtraTokensLeftBehind(L,CM)}{numTracesLog(L) - numTracesExtraTokensLeftBehind(L,CM)+1}$$

The above function F is used to find out that how an individual is fit to a log. In third step of the algorithm, for the creation of next generation genetic operators such as Cross over and Mutation were used. Cross Over operator recombine the existing population, cross point are the task, calculate the probability of cross over and then subsets can be swapped. In Mutation operator, it introduces new material in the population then every task of an individual can be mutated based on mutation probability. Medeiros *et al*. [15] used this algorithm as plug-in in PROM framework and performed experiments on the simulated data. The results showed that this algorithm found all possible business process models that could parse all the trace in the event log.

3.5 Clustering Based Mining Approaches

Process mining approaches based on clustering have been developed in order to solve the problem of complex process model like “spaghetti shape”. Clustering based approaches generate similar process models to explain the behavior of single process and cluster them together as compared to traditional approaches generate only one single mode [16]. Some of the approaches are based on Bag of Activities and K-gram model, usually transom each process instance into a vector in order to analyze each process. These methods do not have information about the order of performed activities and their context. Song *et al*. [17] have proposed that combination of different perspective can be defined by vector such as data, control flow and performance etc. and tried to get better results than previous approaches. The proposed approach is not able to solve the issue of lack of context. Another approach, Edit_Distance, tried to solve the issue by comparing two process instances and assigned the cost by calculating difference between two sequences [16]. There is another method called trace clustering [18] that utilizes robust set of features for calculating process instances similarity in order to create different clusters. Bose *et al.* [19] proposed method presented the general schema of features and statistical technique that detect the changing points and identify changed regions from control flow perspective. Luengo and Sepulveda [20]

extend the work of Bose *et al*. [19] by adding time feature and resultant clusters shared the structural similarity as well as temporal proximity. Finally, Ali *et al*. [21] extended business intelligence to the healthcare domain.

IV. DISCUSSION

In context of process mining many efforts has been made but still most of the challenges described by van der Aalst [22] were not addressed. Current approaches are facing difficulties when mining business process that contain non-trivial constructs or when log contains noise. Most of the approaches assume that the event logs are complete and noise free but this assumption is unrealistic. The list of issues that can be a challenging problem in order to construct a process model can be:

4.1 Mining Hidden Tasks

The log may contain some hidden task or invisible task. These tasks can be used only for routing purpose and are not recorded in the log. Fig. 3 shows that if a model contain hidden task then the resultant model is not the accurate representation of process model. The approach proposed by Song *et al*. [23] is the only one that handles the problem of hidden tasks.

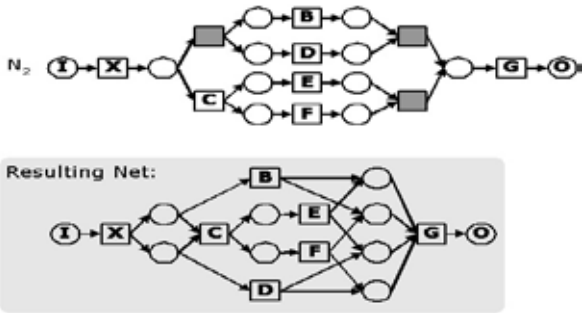

Fig: 3 An Example of Hidden tasks Translation [24]

4.2 Mining Duplicate Tasks

Duplication of one task may occur in event log as depicted in Fig. 4. If multiple transition have same label then they appear as duplicate task and they are treated as single task by process mining approach. Duplicate task tackle by α-algorithm [9] do not consider the redesign problem. Duplicate Tasks are the one issue that is addressed by other researchers [12, 13, 25, 23].

Fig: 4 An Example of Duplicate Task Translation [24]

4.3 Mining loops

Event logs may contain different types of loop. Those loops can be of length one or two they can be sometimes called as short loop. When dependency relationships are extracted from workflow, for the length one loop as shown in Fig. 5. B>B and not B>B implies B® B it is impossible to detect. For length two loop as shown in Figure 5 A>B and B>A implies A||B and B||A instead of A® B and B® A. These types of construct cannot handle by α-algorithm [9]. Other approaches [13, 14] are also covered this problem in their algorithms.

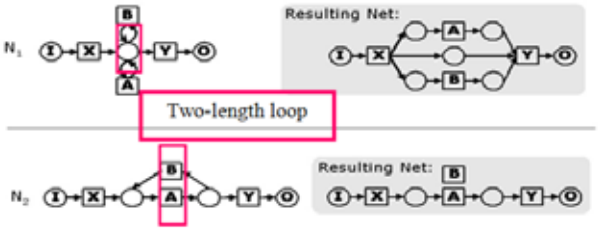

Fig. 5 An Example of Mining Loop Translation [24]

4.4 Mining Non-Free-Choice Constructs

If one task is the input for other two different tasks then that transformation results into non-free choice construct. These types of construct combine choice and synchronization. This type of constructs are difficult to mine by mining algorithm as the choice is non-local and algorithm has to remember earlier events. This problem is addressed by very few researchers. Huang and Zhang [26] and Song *et al*. [23] solve this issue by proposing γ+ algorithm. Other than above mentioned challenges there are some other construct problems, noise and completeness issues that are also not easy to handle in process mining algorithms. Noise can appear if the tasks somehow incorrectly logged or event log reflects exceptional cases. The α – algorithm has so many limitations as discussed before, to solve those problems many researchers extend that algorithm.

Algorithms like heuristic based, α-algorithm based or inductive approach proved to be more significantly time efficient and linear in the size of the log. However, on real-life data such algorithms do not perform well. So, to deal with real life applications more advanced algorithms needed like genetic approach.

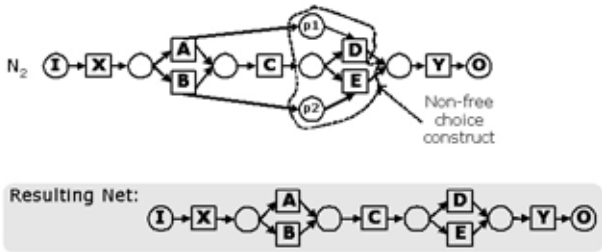

Fig. An example of Non- Free choice construct Translation [24]

But main disadvantage of genetic approach is its time and space complexity. To overcome high computational problem, Bratosin *et al*. [27] proposed distributed genetic approach. They used the coarse grained distributed variant of the genetic miner i.e. plug-in included in Prom Tool and their results showed that it improved time complexity somehow.

From the above discussion, it is clearly seems that none of the technique addresses all of the issues. Non free choice constructs and consideration of noise in the event log is considered by few of the researches. Issues related to duplicate tasks, hidden tasks and non-free choice constructs utmost while others only handle duplicate tasks or loops. Most of the approaches do not handle noise issue. Their assumption of noise free and completeness of event logs is unrealistic. So, we need approach or combination of approaches to address all of those issues in order to get efficient and qualitative process mining.

V. CONCLUSION

In an organization due to many reasons actual work can deviate from process definitions. Therefore, it becomes irresistible for organizations to discover these deviations in order to improve their processes. Process mining allows identification of processes from event logs and the discovery of differences between the prescriptive

process model and the real world process executions. This paper presented the detail comparison of approaches used for process mining. Comparison provided between them also covered the aspect that either they address technical issues or not. To get efficient and qualitative results of business process mining, researchers have to look for comprehensive standard technique or combination of techniques that is based on realistic assumptions. Process mining is a stimulating topic both from a practical and scientific perspective, and it should be further exploited through research in software analytics.

VI. ACKNOWLEDGMENT

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EQUATION OF STATE FOR THE ANALYSIS OF ELASTIC PROPERTIES OF SILICATE PEROVSKITE

B. K. Pandey[1], A. K. Pandey[2] and Chandra Kumar Singh[3]

[1,3] *Department of Applied Sciences, M. M. M. University of Technology, Gorakhpur, (India)*

[2]*Department of Applied Sciences, Sharewood College of Engineering Research and Technology, Barabanki, (India)*

ABSTRACT

In the present work an attempt has been made for the prediction of suitable equation of state on the basis of computed thermoelastic properties and Gruniesen parameter (γ) of Silicate perovskite i.e. $MgSiO_3$ & $CaSiO_3$ up to the compression range $V/V_0=1$ to $V/V_0= 0.6$, using four different empirical isothermal equations of state viz. Brennan-Stacey EOS, Shanker EOS, Vinet EOS and Kholiya EOS. The critical analysis of obtained results suggest that validity of Shanker EOS and Vinet EOS are most suitable for the determination of elastic constants of Silicate Perovskites while the rest of equation of states viz. Brennan-Stacey EOS and Kholiya EOS are less suitable.

***Key Words*: Compression, Thermoelastic Properties, Gruneisen Parameter, Silicate Perovskites And Equation of State.**

I INTRODUCTION

Silicate perovskite is the term given to $(Mg,Fe)SiO_3$ (also known as bridgmanite and $CaSiO_3$ (calcium silicate) when arranged in a perovskite structure. Silicate perovskites are mainly found in the lower part of Earth's mantle, between about 670 and 2,700 kilometers. They are thought to form the main mineral phases, together with ferropericlase. During the last year (2014), the Commission on New Minerals, Nomenclature and Classification (CNMNC) of the International Mineralogical Association (IMA) approved the name bridgmanite for perovskite-structured $(Mg)SiO_3$, in honor of physicist Percy Bridgman, who won the Nobel Prize in Physics in 1946 for his high-pressure research.

Silicate perovskite may form up to 93% of the lower mantle [1] and the magnesium form is considered to be the most abundant mineral in the Earth [2]. The highest proposed abundances of silicate perovskites suggest that the lower mantle is richer in silica than the upper mantle and are consistent with the overall chondritic composition of the Earth[3].Under very high pressures of the lowermost mantle, below about 2700 km, the silicate perovskites are replaced by post-perovskite[3]. The physical properties of silicate perovskites under lower mantle conditions, such as seismic velocity, are studied experimentally using laser-heated diamond anvil cells. Naturally occurring silicate perovskites cannot be studied as they are unstable at the Earth's surface [4].

The perovskite structure (first identified in the mineral perovskite) occurs in substances with the general formula ABX_3, where A is a metal that forms large cation, B is another metal that forms smaller cations and X is typically oxygen. The structure may be cubic, but only if the relative sizes of the ions meet strict criteria. Typically,

substances with the perovskite structure show lower symmetry, owing to the distortion of the crystal lattice and silicate perovskites in the orthorhombic crystal system[5].

In the present work an attempt has been made to test the validity of suitable equation of state been made for theoretical prediction of elastic properties and Gruneisen parameter for Silicate perovskite i.e. $MgSiO_3$ & $CaSiO_3$ perovskites both at high and low compression ranges using four different isothermal equation of state viz. Vinet EOS, Shanker EOS, Brennan-Stacey EOS and Kholiya EOS. We make use of the formulations for γ and its volume derivatives given by Stacey and Davis to obtain results in case of Silicate perovskite.

II THEORY

An EOS can be derived from the volume derivative of lattice potential energy by using the relation

$$P = -\left(\frac{dW}{dV}\right)_T \qquad (1)$$

Where W for an ionic crystal can be written as the sum of electrostatic energy and short range overlap repulsive energy Φ.

Equation of states are derived on taking account of some basic assumptions. Brennan-Stacey EOS[6,7] is based on assumption that Gruniesen parameter is proportional to volume and equation is obtained on account of free volume formula[8],given as follows:

$$P = \frac{3K_0\left(\frac{V}{V_0}\right)^{-\frac{4}{3}}}{\left(3K_0' - 5\right)}\left[\exp\left(\frac{3K_0' - 5}{3}\left(1 - \frac{V}{V_0}\right)\right) - 1\right] \qquad (2)$$

On the basis of a modified exponential dependence for the short range force constant on volume, the Shanker EOS[9,10] is derived, given as follows:

$$P = \frac{3K_0\left(\frac{V}{V_0}\right)^{-\frac{4}{3}}}{\left(3K_0' - 8\right)}\left[\left(1 - \frac{1}{t} + \frac{2}{t^2}\right)\left(\exp ty - 1\right)\right] + \left[y\left(1 + y - \frac{2}{t}\right)\exp ty\right] \qquad (3)$$

Where, $y = 1 - \frac{V}{V_0}$ and $t = K_0' - \frac{8}{3}$

Taking account universal relationship between binding energy and interatomic separation for solids, Vinet EOS [11,12,13] derived given as follows:

$$P = 3K_0 x^{-2}\left(1 - x\right)\exp\left\{h\left(1 - x\right)\right\} \qquad (4)$$

Where, $x = \left(\frac{V}{V_0}\right)^{\frac{1}{3}}$ and $h = \frac{3}{2}\left(K_0' - 1\right)$

Kholiya [14] has expanded pressure in powers of density up to the quadratic term and achieved the EOS as

$$P = \frac{K_0}{2}\left[\left(K_0' - 3\right) - 2\left(K_0' - 2\right)\left(\frac{V}{V_0}\right)^{-1} + \left(K_0' - 1\right)\left(\frac{V}{V_0}\right)^{-2}\right] \tag{5}$$

Isothermal Bulk modulus K_T can be obtained by taking first volume derivative of above three relations as follows:

$$K_T = -V\left(\frac{\partial P}{\partial V}\right)_T \tag{6}$$

Thus taking differentiation of above three pressure-volume relations with respect to volume and putting in equation (4), expressions for isothermal bulk modulus is derived as follows:

$$K_T = \frac{4}{3}P + K_0\left(\frac{V}{V_0}\right)^{-\frac{1}{3}} \exp\left[\left(K_0' - \frac{5}{3}\right)\left(1 - \frac{V}{V_0}\right)\right] \tag{7}$$

$$K_T = \frac{4}{3}P + K_0\left(\frac{V}{V_0}\right)^{-\frac{4}{3}} \exp\left[\left(K_0' - \frac{8}{3}\right)\left(1 - \frac{V}{V_0}\right)\right] \tag{8}$$

$$K_T = K_0 x^{-2}\left[1 + \left\{(1 + hx)(1 - x)\right\}\right]\exp h(1 - x) \tag{9}$$

$$K_T = K_0\left(K_0' - 2\right)\left(\frac{V}{V_0}\right)^{-1}\left[\left(\frac{K_0' - 1}{K_0' - 2}\right)\left(\frac{V}{V_0}\right)^{-1} - 1\right] \tag{10}$$

Pressure derivative of isothermal bulk modulus K_T gives first pressure derivative of bulk modulus K_T' as follows:

$$K_T' = \frac{16}{9}\frac{P}{K_T} + \left(1 - \frac{4}{3}\frac{P}{K_T}\right)\left[\left(K_0' - \frac{5}{3}\right)\left(\frac{V}{V_0}\right) + \frac{5}{3}\right] \tag{11}$$

$$K_T' = \frac{16}{9}\frac{P}{K_T} + \left(1 - \frac{4}{3}\frac{P}{K_T}\right)\left[\left(K_0' - \frac{8}{3}\right)\left(\frac{V}{V_0}\right) + \frac{8}{3}\right] \tag{12}$$

$$K_T' = \frac{1}{3}\left[\frac{x(1 - h) + 2hx^2}{1 + (hx + 1)(1 - x)} + hx + 2\right] \tag{13}$$

$$K_T' = \frac{\left(K_0' - 2\right)\left(\frac{V}{V_0}\right) - 2\left(K_0' - 1\right)}{\left(K_0' - 2\right)\left(\frac{V}{V_0}\right) - \left(K_0' - 1\right)} \tag{14}$$

Equations (2), (7) and (11) corresponds to Brennan-Stacey EOS. Equation (3), (8) and (12) corresponds to Shanker EOS. Equations (4), (9) and (13) corresponds to Vinet EOS and (5), (10) and (14) correspond to Kholiya EOS. In

the above equations K_0 is isothermal bulk modulus and $K_0^{'}$ is the first pressure derivative of isothermal bulk modulus at zero pressure value.

All these EOS are also tested for the basic criteria which must be satisfied by an EOS for its validity and applicability as suggested by Stacey [14, 15, 16]. These criteria are as follow;

(1) In the limit $P \to \infty$, $\frac{V}{V_0} \to 0$.

(2) With the increase in pressure isothermal bulk modulus must increase continuously and in the limit of infinite pressure $K_T \to \infty$.

(3) $K_T^{'}$ must decrease progressively with the increase in pressure such that $K_T^{'}$ remains greater than 5/3 in the limit of infinite pressure.

Gruniesen parameter γ derived by Barton-Stacey [17, 18] is given by following expression:

$$\gamma = \frac{\frac{1}{2}K_T^{'} - \frac{1}{6} - \frac{f}{3}\left(1 - \frac{P}{3K_T}\right)}{\left(1 - \frac{4}{3}\frac{P}{K_T}\right)} \qquad (15)$$

Where, f =2.35 a constant, K_T is isothermal bulk modulus and $K_T^{'}$ is the first pressure derivative of isothermal bulk modulus.

III RESULT AND DISCUSSION

In the present work we have computed the pressure P, isothermal bulk modulus K_T, first pressure derivative of isothermal bulk modulus K_T', and Gruneisen parameter for $MgSiO_3$ & $CaSiO_3$ perovskites. In This calculation we have used four different EOS viz Brennan-Stacey EOS, Shanker EOS, Vinet EOS & Kholiya EOS. The expressions of P for these EOS are given in equations 2, 3, 4 and 5 respectively. K_T for these EOS is computed by using equations 7, 8, 9 and 10 respectively. The value of K_T' is obtained by using equations 11, 12, 13 and 14 respectively. Using different parameters corresponding to the different EOS required in equation 15 the Gruneisen parameter has been calculated. Input parameters are given in Table-1. The calculated values of elastic parameters P, K_T, K_T' and γ are given in Table-2 &3 for $MgSiO_3$ perovskite and Table-4 &5 for $CaSiO_3$ perovskite. Graphs are plotted for P vs V/V_0, K_T vs P, K_T' vs P and γ vs V/V_0 for $MgSiO_3$ perovskite are given in Fig.1 to Fig. 4 and the plots for P vs V/V_0, K_T vs P, K_T' vs P and γ vs V/V_0 for CaSiO3 perovskites are given in Fig.5 to Fig. 8. The critical analysis of the graphs suggests that $P \to \infty$, $\frac{V}{V_0} \to 0$ clearly evident from Fig. (1) & from Fig. (5). From the Fig. (2 & 6) it is observed that with the increase in pressure in terms of compression ratio, isothermal bulk modulus increases continuously. Fig. (3 & 7) shows that $K_T^{'}$ decreases as the pressure P gets increased. It verifies

the constraint which states that the pressure derivative of isothermal bulk modulus must decreases progressively with the increase in pressure.

Again analyzing the graph plotted between V/V_0 vs g by using different isothermal EOS as shown in Fig. (4 & 8), it is observed that the variation of elastic parameters such as K_T , K_T' and pressure for MgSiO3 & CaSiO3 perovskites are well satisfied by all four different EOS viz Brennan-Stacey EOS, Shanker EOS, Vinet EOS & Kholiya EOS used in present computation. For better approximation graph between g vs Ω (V/V_0) must be a straight line[19] .On the observation of slope of graphs between V/V0 vs g (Fig.4 & Fig.8) it is clear that Shanker EOS and Vinet EOS are most suitable for the determination of elastic constants of Perovskites while the rest of equation of states viz. Brennan-Stacey EOS and Kholiya EOS are less suitable.

Table-1 Input parameters [20]

Mineral	K_0(GPa)	K'_0
MgSiO3 Perovskite	261	4.0
CaSiO3 Perovskite	232	4.8

Table-2 Calculated values of P & KT at different compression for MgSiO3 Perovskite

V/V0	P(VEOS)	P(B-S)	P(Shnkr)	P(Kholiya)	K_T(Vinet)	K_T(B-S)	K_T (Shnkr)	K_T (Kholiya)
1	0	0	0	0	261	261	261	261
0.95	14.82	14.82	14.83	14.82	318.29	318.12	318.51	318.12
0.9	33.86	33.83	33.88	33.83	387.35	386.48	388.39	386.67
0.85	58.34	58.22	58.42	58.25	471.1	468.62	473.82	469.62
0.8	89.92	89.57	90.11	89.72	573.35	567.77	578.99	570.94
0.75	130.89	130.01	131.21	130.5	699.13	688.13	709.5	696
0.7	184.37	182.44	184.8	183.77	855.26	835.2	872.85	852.24
0.65	254.82	250.9	255.16	254.05	1051.04	1016.36	1079.41	1050.18
0.6	348.61	341.05	348.38	348	1299.46	1241.66	1343.66	1305

Table-3 Calculated values of K'_T & γ (Gruneisen Parameter) at different compression (V/V_0) of $MgSiO_3$

V/V_0	K'_T(Vinet)	K'_T(B-S)	K'_T(Shnkr)	K'_T(Kholiya)	γ (VEOS)	γ (B-S)	γ (Shnkr)	γ (Kholiya)
1	4	4	4	4	1.05	1.05	1.05	1.05
0.95	3.77	3.72	3.77	3.73	1.01	0.99	1.01	0.99
0.9	3.57	3.48	3.57	3.5	0.97	0.92	0.97	0.93
0.85	3.38	3.27	3.39	3.31	0.93	0.86	0.93	0.88
0.8	3.22	3.07	3.24	3.14	0.88	0.79	0.89	0.84
0.75	3.06	2.89	3.09	3	0.84	0.73	0.85	0.8

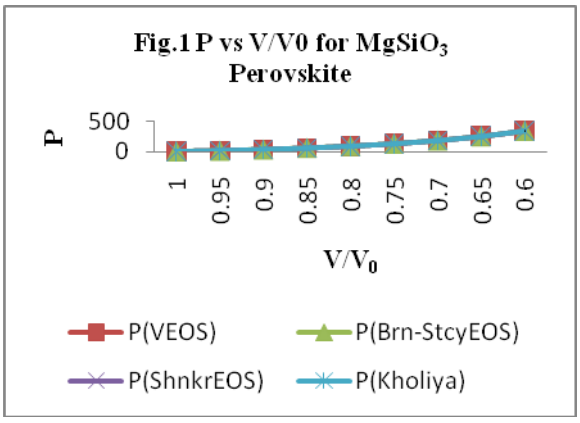
0.7	2.92	2.73	2.96	2.88	0.79	0.66	0.82	0.76
0.65	2.78	2.57	2.84	2.76	0.74	0.6	0.78	0.73
0.6	2.65	2.43	2.73	2.67	0.7	0.53	0.74	0.7

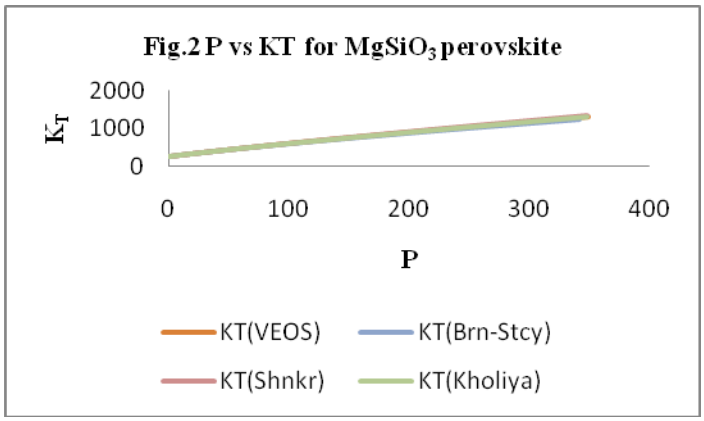
Table-4 Calculated Values of P & K_T at different compression for $CaSiO_3$ Perovskite

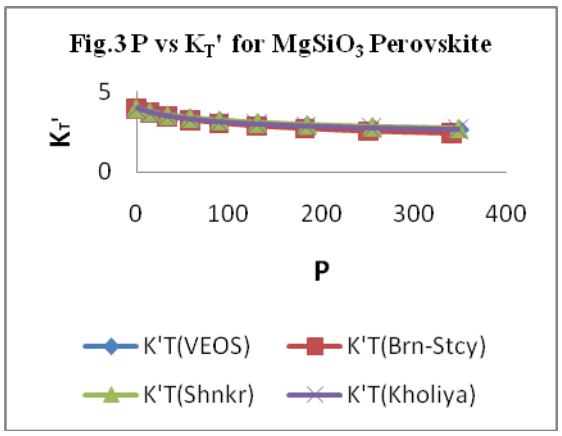
V/V0	P(Vinet)	P(B-S)	P(ShnkrEOS)	P(Kholiya)	K_T(VEOS)	K_T(B-S)	K_T(Shnkr)	K_T(Kholiya)
1	0	0	0	0	232	232	232	232
0.95	13.45	13.45	13.45	13.43	294.03	293.96	294.32	293.05
0.9	31.37	31.36	31.41	31.22	370.99	370.52	372.36	366.62
0.85	55.24	55.17	55.37	54.67	467.04	465.43	470.63	455.97
0.8	87.11	86.87	87.42	85.55	587.77	583.57	595.19	565.5
0.75	129.84	129.17	130.41	126.31	740.71	731.12	754.24	701.16
0.7	187.48	185.84	188.35	180.39	936.28	916.88	959.03	871.18
0.65	265.94	262.24	266.94	252.73	1189.77	1151.56	1225.29	1087.24
0.6	373.93	366.07	374.4	350.58	1519.97	1451.38	1575.38	1366.22

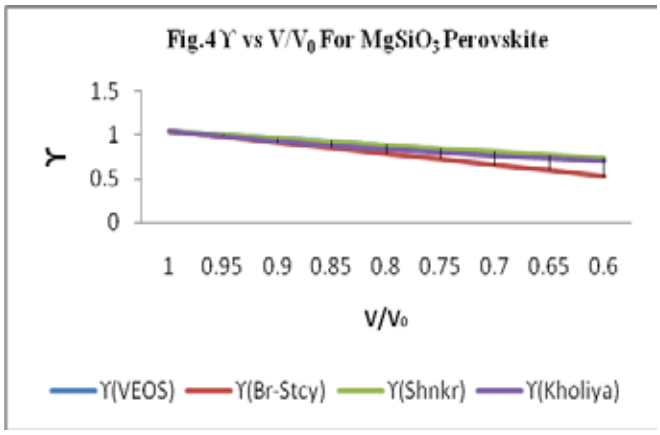
Table-5 Calculated Values of K'_T & γ (Gruneisen parameter) for CaSiO3 Perovskite

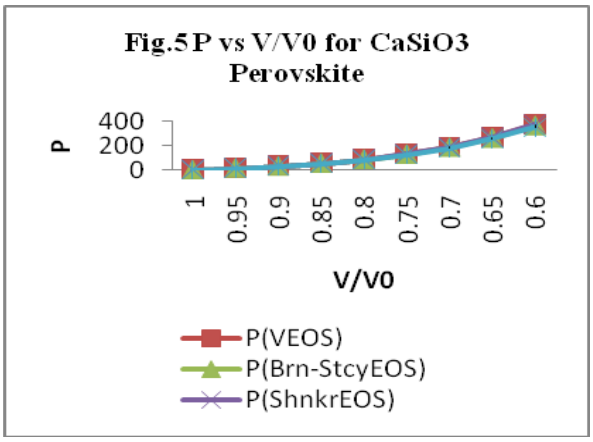
V/V_0	K'_T(VEOS)	K'_T(B-S)	K'_T(Shnkr)	K'_T(Kholiya)	γ (VEOS)	γ (B-S)	γ (Shnkr)	γ (Kholiya)
1	4.8	4.8	4.8	4.8	1.45	1.45	1.45	1.45
0.95	4.48	4.44	4.49	4.33	1.39	1.37	1.39	1.31
0.9	4.21	4.13	4.22	3.97	1.32	1.28	1.33	1.19
0.85	3.97	3.86	3.99	3.68	1.26	1.2	1.27	1.09
0.8	3.75	3.61	3.78	3.44	1.2	1.11	1.22	1.01
0.75	3.56	3.38	3.59	3.24	1.14	1.03	1.16	0.94
0.7	3.38	3.18	3.42	3.07	1.08	0.95	1.1	0.88
0.65	3.21	2.98	3.26	2.92	1.02	0.86	1.04	0.83
0.6	3.06	2.8	3.12	2.79	0.96	0.78	0.98	0.78

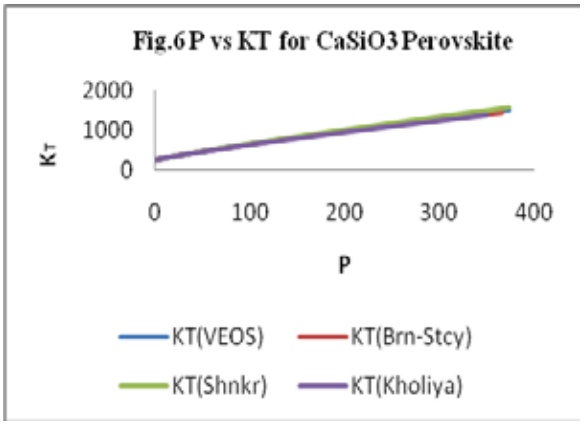


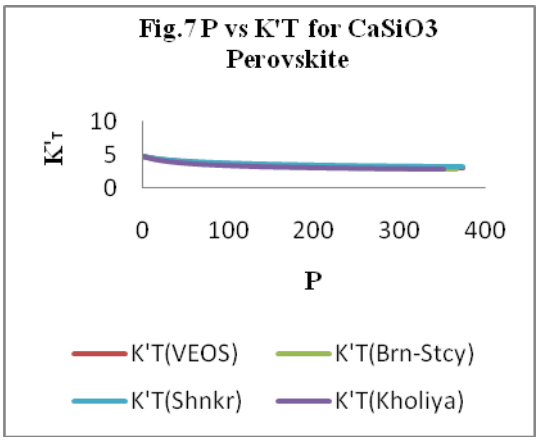


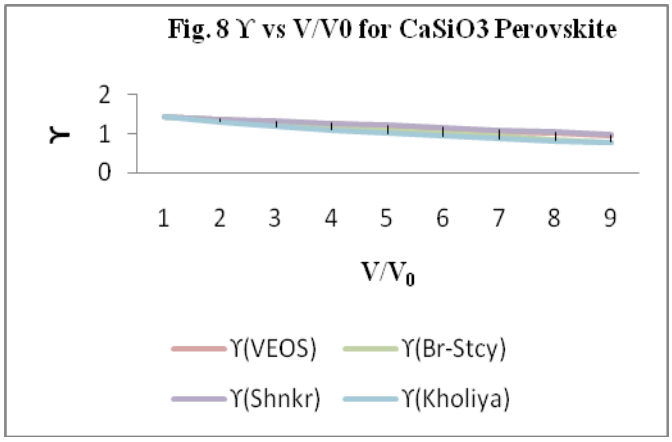












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DIVERSE APPLICATIONS OF ALGAE

Garima Goswami[1], Vinal Bang[2], Shubham Agarwal[3]

[1,2,3] *Department of Applied Sciences (Chemistry)*

JIET Universe (co-ed campus), NH-62, Pali Road, Mogra, Jodhpur (Rajasthan), (India)

ABSTRACT

Living system on earth comprises of plants and animals. Plants are everywhere. They are primary producers which is a source of many nutrients. Algae are a very large and diverse group of autotrophic organisms which ranges from unicellular to multicellular forms with high protein content. At the same time, algae are important producers of vitamins, minerals and fatty acids also. Many species of algae find their applications in food, dairy, pharmaceutical, cosmetics and industry. Certain beverages are prepared from sea algae. Mainly marine algae have been used as food and medicine for many centuries. Algae is not only used as food but also used as extracts in food, dairy, cosmetics, and industrial uses. Edible algae are recognized as complete foods which provide correct balance of proteins, carbohydrates, vitamins, and minerals. The importance of investigating new options offered by algae cultivation is motivated by the fact that algae are very efficient at converting light, water and carbon dioxide (CO_2) into biomass in a system that does not necessarily require agricultural land. Therapeutic properties of algae is used for promotion of health .Algae is used as one of important medical source due to its antioxidant, anticancer, antiviral properties. Scientists are looking for biologic drugs which are cheaper than the existing chemical drugs. The biologic drugs manufactured in mammalian cell culture or by bacteria or yeasts for treating diseases like diabetes, multiple sclerosis and cancer cost too much. The alternate is green algae, which is abundant, resilient, cheap to grow, and efficient at folding complex proteins. Various industrial products are made up from macro algae also. They can act as antibiotics, antihypertensive agents, and cholesterol reducers in blood, dilatory agents, anticoagulants, insecticides, and anti-tumorigenic agents. In cosmetics, the role of algae is as water-binding agents, thickening agents, and antioxidants. Some algae are also potential skin irritants. Most algae do not have lignin associated to the cellulose of the plant cell wall, so the cellulose extraction is easier, less expensive and produces microcrystalline cellulose with chemical properties that can optimize the use of traditional cellulose in some applications as paper production, cosmetics, medicines and membrane filtration.

Keywords: Algae, Biomass, Cellulose, Food, Medicines, Nutrients.

I INTRODUCTION

With the development of our society, in the entire dimension, there has been an increase in the demand of fuel for fulfilling the energy requirements. To fulfil this need, our dependence on the fossil fuels has increased and this is resulting in a significant decline in the quality of these fossil fuels. The other non-conventional energies like solar-, wind, tide energy etc. require expensive equipment to make them usable. Hence, we have an urgent need to find an

alternative to this problem. One of the substituent to fossil fuel and nonconventional energy resources is "ALGAE". Algae are proving themself to be a potential energy generator, and besides energy production, it can be used in a number of different ways. It can be used as a food product and food additive, animal and fish feed, in cosmetics, medicines etc. Besides thus, algae have many benefits linked to it.

II ADVANTAGES OF USING ALGAE

Algae is proving itself to be one of the most promising and long term source of food, animal feed, medicines, cosmetics other co-products and most importantly oil for fuel. They are found in a large number and have a wide variety of benefits associated with them which makes them so attractive. Algae have evolved over billions of years to produce and store energy in the form of oil. It is done more efficiently than any other process, be it natural or engineered. [1]

a. Growth rate of Algae is high.

Number of algae is doubled every few hours, can be grown daily and the biomass and biofuel produced is many times greater than any of our most productive crop

b. High yields of Biofuel

Energy in algae is stored in Algae in form of oils and carbohydrates which when multiplied with its number give us a very large amount.

c. Consumes CO_2

Since algae are plant, it absorbs CO_2 and releases O_2 as it grows. More the amount of CO_2 , more is its productivity.

d. No competition with Agriculture

Algae can be grown anywhere, i.e. on the land which is not suitable for the production of other crops, water sources such as seawater, waste water etc. which are not suitable for other crops.

e. Wastewater can be purified

Algae can be grown in nutrient-rich waters like municipal waste waters (sewage), animal wastes and some industrial effluents, while purifying these wastes at the same time and producing a biomass suitable for biofuel productions.

f. Biomass used as Energy Source

The biomass which is left after the extraction of oil is pelletized and then used in industrial boilers and power generation houses as a fuel

g. Produces industrially useful products

Plastics, chemicals, feedstock, lubricants, fertilizers, cosmetics, and many other products can also be produced using algae.

h. Biomass used as feed and food also

Algae in addition to fuel can be used as an animal feed and the biomass remaining can be also used as a food supplement.

i. Job creating Industry

Algae can be grown in a variety of ways using a variety of methods, which will create a large number of jobs ranging from research to engineering, construction to farming, from marketing to financial services

III APPLICATIONS

3.1Biofuel

Because of the high oil content and rapid biomass production, Algae has been recognised as a potentially good source of biofuel production. There are a no. of methods for the production of biofuel using algae.

3.1.1 Biodiesel

Algae can potentially contain over 80% total lipids. However, if the production is under normal conditions then the lipid concentration is low (less than 40%) and high oil content is always associated with very low yields. Under stress conditions like insufficient nitrogen availability, the production of various lipids can be stimulated. But due to this the non-lipid part of the biomass is reduced which can be used as a source for other co-products.[2]

3.1.2 Hydrocarbons

Some algae like, *Botryococcus,* does not produce lipids, instead it produces long chained hydrocarbons, unsuitable for diesel production. They can be converted to hydrocarbon chain suitable for diesel production by similar process by which conventional fuels are derived from fossil fuels.

3.1.3 Ethanol

It is generally produced by feedstock containing starch. Polysaccharides present in the algal cell wall could be used as a feedstock in a process similar to cellulosic ethanol production. It has an extra advantage as lignin is rarely found in algae. Also the polysaccharides generally breakdown easily as compared to the woody biomass. [3]

3.1.4 Biogas

When wet biomass undergoes anaerobic digestion than the organic matter is converted to biogas containing 60-70%biomethane and rest CO_2. It has many advantages like, CO_2 produced can be fed back to algae, no need of drying as the process uses wet biomass, nutrients present in digested biomass can be recovered from liquid and solid phase.

3.1.5 Thermochemical Treatment

Under very high pressure and temperature, biomass undergoes a chemical conversion. It ends up in a raw gaseous, liquid or solid phase, depending on the content of water and the extreme conditions applied, which can be upgraded to use as a biofuel. But the energy intake in this process is high in comparison to the production of biogas.[4]

3.1.6 Hydrogen

Hydrogen gas is produced by some algae by manipulating it. But the yield is low as the cells loses energy during formation of hydrogen, due to which less biomass is produced and hence lesser co-production.

3.1.7 Bioelectricity

It can be used for combustion in power plants, but it requires a lot of energy as it needs to be dried before combustion.

3.2 Cosmetics

Algae have natural anti-cellulite and anti-ageing properties. It helps in increasing the elasticity and suppleness of the skins and also stimulates the renewal of damaged skin cells. It can detoxify and cleanse and tone the skin. It increases the lusture of hair, has a moisturizing and softening effect on hair. It forms a gel on reacting with

proteins, which has a moisturizing effect on the skin and softens skin and can produce soothing face packs and masks. It has been known long for its anti-inflammatory and tissue renewal properties which can have a positive effect on problems such as facial wrinkles. It has hydrating properties and forms a protective layer on the skin thus acts as a moisturiser and reduces loss of skin moisture through evaporation.[5]

Algal Specie (Common Name)	Chemical Name	Type	Properties and produc
Bladderwrack	Fucusvesiculosus	Brown algae	Anti-Aging, Anti-inflammatory, Nutritive, Softens Skin, Hair Shine, Skin Firming, Healing, Skin Elasticity, Skin Soothing
Dulse	Palmariapalmata	Red algae	Cleansing, Toning, Skin Soothing, Nutritive, Healing, Anti-Cellulite
Irish Moss	Chondruscrispus	Red algae	Emollient, Moisturizing, Sheaths damaged or dry hair, Nutritive, Skin Soothing, Anti- Inflammatory
Kelp/Kombu	Macrocystispyrifera	Brown algae	Anti-Inflammatory, Nutritive, Skin Elasticity, Healing, Skin Softening, Moisturizing
Laminaria	Porphyraumbilicalis	Brown Algae	De-Toxification, Revitalizing and Firming for Skin, Purifying, Nutritive, Anti-Cellulite
Nori/Laver	Porphyraumbilicalis	Red algae	Stimulates Hair Growth, Strengthens Hair, Nutritive, Moisturizing
Sea Lettuce	Ulvalactuca	Green algae	Antioxidant, Anti-Inflammatory, Skin Elasticity, Collagen Synthesis, Anti-Wrinkle, Emollient, Moisturizing
Sea Palm	Postelsiapalmaeformis	Brown algae	Skin Softening, Anti-Wrinkle, Nourishing, Moisturizing, Anti-Inflammatory, Antiseptic, Hair Shine
Spirulina	Spirulina maxima	Blue algae	Anti aging, Anti-Wrinkle,

			Collagen Synthesis, Anti-Inflammatory, Nourishing
Wakame	Undariapinnatifida	Brown algae	Antioxidant, Skin revitalizing, Anti Wrinkle, Moisturizing, Skin Smoothing, Sunscreen, Anti-Obesity

3.3 Fertilizers

From ancient time, Algae has been used as a fertilizer in many parts of the world. Algae have a high mineral content and have a property to help increase the water binding capacity of soil. It is capable of fixing atmospheric nitrogen and thus can be used to make bio fertilizers. Algae can be grown simultaneously with the other crops and it will provide the crops with the most basic and important element to grow, that is, nitrogen. Also, plants fertilized with algae resists diseases and attacks by insects. Moreover algae maintain and build up the soil fertility thus increasing the yield. It also improves the physio-chemical properties, helps in gradual build-up of nitrogen and carbon in soil, and improves the pH and the electrical conductivity. There is also an improvement in the grain quality.

Blue green algae belonging to genera Nostoc, Anabaena, Tolypothrix and Aulosira fix atmospheric nitrogen.[6]

3.4 Health Food and Pharmaceuticals

Medicines, vitamins, vaccines, nutraceuticals, and other nutrients which when made using animals or plants are very expensive. All these can be produced using algae. Many types of algae and the products derived from them have shown medicinal values and nutritional applications.[7,8]

3.4.1 Pigments

There is a variety of pigments present in microalgae which are associated to light incidence. Some of the most important pigments are

3.4.1.1 Chlorophyll

The primary photosynthetic compound

3.4.1.2 Phycobiliproteins

Improves the efficiency of light energy utilization

3.4.1.3 Carotenoids

Protects algae against the solar radiations and their adverse effects

3.4.1.3.1 β-Cartene

Used as a vitamin A precursor

3.4.1.3.2 Lutein, Zexantin and Canthaxantin

Used in Chicken skin coloration and also for other pharmaceutical purposes

3.4.1.3.3 Astaxanthin

Used in aquaculture to provide fishes like salmon its natural red colour.

Natural food colorant in juices, chewing gum, ice sorbets, candies, soft drinks, dairy products etc. also uses pigments from algae.[9]

3.4.2 Polyunsaturated Fatty Acids(PUFAs)

These are important nutrients which cannot be produced by the organisms itself and thus is supplied to the body externally. Omega-3 fatty acids are the well-known PUFAs and are usually obtained from the fish oil. But fishes cannot produce PUFAs, these get accumulated in their body when they eat algae and hence algae are their true sources. In present time, PUFAs are directly being produced by algae with advantages of not having the unpleasant fish odour, is easily purified and in a better way, and the risk of contamination and reaction is also reduced.

PUFAs are important for our body as they help in fighting many diseases like cardiovascular diseases, reduce obesity, regulate membrane fluidity, and also regulate oxygen transport and improve thermal adaption ability.

3.4.3 Other Bioactive Algal Products

3.4.3.1 β-1,3-glucan, an active immune stimulator, is the most important algal compound from a medical point of view. It is a free radical scavenger and also a blood lipid reducer. It can be used against gastric ulcers, wounds and constipation. It prevents action against atherosclerosis, hypercholesterolemia and also shows anti-tumor action. It is very efficient in performing the mentioned.

3.4.3.2 Microalgae is a source which provides almost all essential vitamins,that is, A, B1, B2, B6, B12, C, E, nicotinate, biotin, folic acid and panthothenic acid.

3.4.3.3 Sulfated Polysaccharides of microalgae is effectively used for anti-adhesive therapies against bacterial infections for both warm and cold blooded animals.

3.5 Aquaculture Feed

3.5.1 Bivalves, Shrimps and some finfish cultures has an essential requirement for microalgae in the processes of hatchery and nursery.

3.5.2 Zooplanktons, which are served to freshly hatched carnivorous fish, require microalgae for their production.

3.5.3 The red characteristic color of wild salmon’s and trout’s muscles is acquired by them when they eat green algae, which is not so in cultured fishes, thus reducing market value. Astaxanthin can be added to the feed of cultured fishes which provides them their characteristic red colour.[10]

3.6 Food Additives

There has been an increased use of phycocolloids in prepared foods. The major phycocolloids are

3.6.1 Agar

It is obtained from different species of red algae and usually from algae Gelidium. It has a wide range of applications

3.6.1.1 Food Products

3.6.1.1.1 Frozen foods

3.6.1.1.2 Bakery icings
3.6.1.1.3 Meringues
3.6.1.1.4 Dessert gels
3.6.1.1.5 Candies
3.6.1.1.6 Fruit juices
3.6.1.2 Other Applications
3.6.1.2.1 Industry Uses
3.6.1.2.1.1 Paper sizing/coating
3.6.1.2.1.2 Adhesives
3.6.1.2.1.3 Textile printing
3.6.1.2.1.4 Casting
3.6.1.2.1.5 Impressions
3.6.1.2.2 Biological Culture Media
3.6.1.2.3 Medical/Pharmaceuticals
3.6.1.2.3.1 Bulking agents
3.6.1.2.3.2 Laxatives
3.6.1.2.3.3 Suppositories
3.6.1.2.3.4 Capsules
3.6.1.2.3.5 Tablets
3.6.1.2.3.6 Anticoagulants

3.6.2 Alginates

It is extracted from brown weeds (especially Macrocystis, Laminaria, and Ascophyllum) and is better known as Alginic acids. It has applications in textile industry for cotton yarn sizing. Food and pharmaceutical industry also uses Alginates in ice cream making for smooth texture and prevention of ice formation (because of its chelating ability to form highly viscous solution), as emulsifiersand thickeners in syrups, and in candies and salad dressing as fillers. It is technologically also very important mainly because of its gelling properties.

3.6.3 Carrageenan

It is a group of water soluble polysaccharides and is used as emulsifiers and stabilizers in numerous foods more widely than agar. It is extracted from different red algae found in different places of the world (Eucheuma in the Philippines, Chondruscrispus in the United States and the Canadian Maritime Provinces, and Iridaea in Chile). Chocolate milk, ice cream, evaporated milk, puddings, jellies, jams, salad dressings, dessert gels, meat products and pet foods, especially uses κ - and ι- carrageenans mainly due to their thickening and suspension properties. It can also be used for pharmaceuticals like antitumor, antiviral, anti-coagulant and also for immunomodulation activities.

3.7 Food

For hundreds of years, green micro-algae have been used in Asiatic Countries as nutritional supplement or food product. Algae is a rich source of carbohydrates, protein, enzymes and fiber and many vitamins and minerals like

vitamin A, C, B1, B2, B6, niacin, iodine, potassium, iron, magnesium and calcium. Thus, it is presently used as a major source of food throughout the world and especially in Asian countries like China, Japan and Korea.[11],[12] There are approximately 500 species which are eaten by humans. Laminaria species (brown algae) are eaten with meat or fish and in soups. The green algae Monostroma and Ulva which look like lettuce leaves are eaten as salads or in soups, relishes, and meat or fish dishes.

IV CONCLUSION

With so many advantages linked to it, algae can prove to be one of the most used source for energy generation, and for the production of other products like cosmetics, food additives, nutraceuticals, as a food product itself, fertilizers, purifiers and many more. Use of algae should be encouraged. It will not only help us in making an ecofriendly environment but also will create a lot of jobs in almost all the sectors. Production of Algae is also not a typical task, and while growing, it will solve other environmental problems like purification of water, emission of large amount of CO_2, proper usage of barren land and many more.

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