# Alternate management of paddy straw to avoid field open burning and pollution

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**ABSTRACT**

*The problem of pollution caused by burning of straws in the agricultural states of Punjab and Haryana is so severe that in 2012 the US' National Aeronautics and Space Administration released a satellite image showing fires across millions of hectares of agricultural fields in the region. The smog and haze it caused even affected Delhi situated 100 km the burning of straw heated land and killed soil microorganisms, harming its productivity. Smog is causing breathing problems. Open burning of rice straw causes release of air pollutants, which contributes to enhance climate change related issues. Moreover, the burning practice was a reason of losing carbon content from crop land to the atmosphere. Finally, economic and environmental benefits associated to alternative rice straw management options has to be considered and discussed against traditional open burning practices.*

***Key words***—*Rice straw, smog, air pollutants*

## I. INTRODUCTION

Due to mechanization of paddy harvest, the crop residue that remains in the field is of larger quantity and when burnt causes larger smoke quantity, a Punjab State Farmers Commission consultant said(1). The straw management equipment is costly and the process time consuming.

The stubble problem was not as severe when paddy was harvested manually because the farmers use to cut it as close to the ground as possible.

## II. METHODOLOGY

### 2.1 Livestock Feed

Feeding trials to determine the value of rice straw for livestock feed were conducted by the Department of Animal Science at UC Davis in conjunction with the USDA Western Regional Research Center in Albany, California.

Studies focused on the value of rice straw in mixed rations for beef calves and lambs and whether feeding value could be improved by treating the straw with ammonia (NH3) and sodium hydroxide (NaOH).

Results show that rice straw must be supplemented with other feeds, even if used as a maintenance ration for livestock. It is too low in digestible energy, crude protein, calcium, and phosphorus to be used alone. It also has low levels of cobalt, copper, manganese, and sulfur, suggesting possible borderline dietary deficiencies of these minerals.

### 2.2 Treated straw

Feeding value of rice straw is significantly improved when it is treated with sodium hydroxide or ammonia, both of which improve the digestibility of cellulose, which is 35 to 40 percent of the straw. Feeding trials demonstrated that treated rice straw is consumed more readily than untreated straw by cattle and sheep. It is also a better source of carbohydrate and produces more weight gain. Lambs fed diets containing 65 percent rice straw that had been treated with NaOH gained substantially more weight than did those receiving untreated straw. Treatment of the straw with NH3 produced comparable gains. Clearly, chemical treatment improved the feeding value of rice straw.

## III. FIBERBOARD

About 3,000 pounds of rice straw was used in experiments incorporating rice straw with wood chips in making fiberboard. The research was done by the Washington Iron Works. The fiber production was done at the C.E. Bauer Process and Equipment Laboratory, Springfield, Ohio.

A medium-density fiberboard was successfully produced from a 50/50 mixture of rice straw and California hardwood chips. The fiberboard was somewhat dark, taking on the color of the wood chips. The straw was chopped into short lengths and screened to remove dust and fine particles. It was then mixed with wood chips and processed with a steam pressurized refiner designed for refining wood chips. The resulting fibers were trucked to the Washington Iron Works in Seattle for drying and conversion into medium-density fiberboard panels(2)

## IV. PAPER AND DISSOLVING-GRADE PULPS

Pulp is used in making paper and cellulose products that have many industrial uses. Although rice straw has never been used as a source of pulp in the United States, it has been used for many years in Egypt for making commercial grade paper and in China for high grade artistic paper. Neither of these countries have the wood resources of the United States. Paper made in Egypt is from a mixture of rice straw pulp and a high grade pulp from wood imported from Scandinavia.

Rice straw pulps have been prepared which have alpha-cellulose contents and degrees of polymerization comparable to those found in dissolving pulps manufactured from wood

## V. GASIFICATION FOR ENERGY

Preliminary analyses were made in 1973 of various systems for harvesting, transporting, stockpiling, and processing rice straw for energy generation. In subsequent years, studies suggested that baling was the most practical method for collecting the straw and that the moisture content must be near or below 17 percent, wet basis, for safe storage. All standard balers required some modification for handling rice straw. All encountered difficulties in wet field conditions(3)

### 5.1 The gasification process

Gasification is the thermo-chemical process required to convert rice straw to a gas type of fuel that could replace natural gas and diesel Fluidized bed gasification has been investigated since 1981 as a method to produce low Btu gas from rice straw. The system uses a bed of sand inside a refractory-lined cylinder reactor. The fuel (rice straw) is injected into the sand bed which is fluidized by air injected from below. The injected air provides only one-fifth to two-fifths of the amount needed for total combustion.

The straw is processed through a hammer mill before entering the fuel-feed system. The system can convert 500 to 1,000 pounds of rice straw per hour to hot raw producer gas that captures 60 to 65 percent of the energy in the raw fuel(4).

Producer gas is a mixture of combustible gases carbon dioxide, hydrogen, methane, and a small amount of higher carbon gases. It also contains water vapor and nitrogen gas. The combustible gases range from 25 to 40 percent by volume of total gases(5).

## VI. CONVERSION TO SUGAR SYRUP AND YEAST PROTEIN

Sugar syrup and yeast protein were produced from rice straw in the laboratory by the Department of Environmental Toxicology at UC Davis. The most successful procedure produced 25 grams of sugar from 100 grams of rice straw. The sugar was used to produce a food grade yeast. The yeast single-cell protein was comparable to other protein sources when the yeast was fed to mice at 50 percent of the total protein source. A lower nutritional value was obtained when the yeast single cell protein was fed as the sole protein source(6).

## VII. CONCLUSIONS

Open burning of rice straw in the paddy fields releases pollutants into the atmosphere that contribute to enhance climate change issues. Alternative management options for rice straw have been suggested in this study that will lead to less pollution and safety from smog which is causing various problems to our ecosystem(7)

## REFERENCES

[1] Pollution Control Department of Thailand, "Thailand Country Report: Land and Forest Fire and Haze Situation in 2012 and Preparations for 2013," presented at the Joint Graduate School of Energy and Environment, Bangkok, Thailand, *December 4, 2012*.

[2] M. O. Andreae and P. Merlet, "*Emission of trace gases and aerosols from biomass burning*" Global Biogeochemical Cycles, vol. 15, *no. 4, pp. 955-966, December 2001*.

[3] J. S. Levine, Biomass Burning and Global Change, 1st ed., London, England: The MIT Press, Introduction, pp. xxxv-x1iii, *1996*.

[4] M. O. Andreae and P. J. Crutzen, "Atmospherice Aerosols: Biogeochemical Sources and Role in Atmospheric Chemistry," Science, *vol. 276, pp. 1052-1058, May 1997*.

[5] *Office of Agricultural Economics of Thailand "Thailand Country Report*: Fundamental Agricultural Statistics *2010," 2011.*

[6] P. Cheewapongphan and S. Garivait, "Greenhouse gases emission from rice field residues open burning," Proc. 1st National Carbon Neutral Conf., pp. 501-511, Nonthaburi, Thailand, 2010. *International Journal of Environmental Science and Development, Vol. 4, No. 2, April 2013 122*

[7] K.. Kanokkanjana and S. Garivait, "Carbon Released from Open Burning of Agricultural Residues in Thailand," presented at the iLEAPS SC- Science Conference, Garmisch-Partenkirchen Congress Centre, Germany, *September 18-23, 2011*.