# Scope for parallel units in a paper complex of energy conservation

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SUMMARY

Undoubtedly adequate measures for energy conservation through optimum design and efficient plant operations should be adopted at every small and big paper mill. However, a suitable combination of processing units may provide great economic advantage due to enlarged commercial base and considerable energy savings. In this context the need for setting up a sugar mill and a starch plant at the paper mill premises has been examined. A strong case for a paper-sugar-starch complex has emerged.

Indian paper industry is a typical mix of small and large mills. While wood and bamboo are the principal raw materials for large mills, the smaller units process bagasse, recycle paper, grasses and other agricultural residues. There are over 180 paper mills in operation presently with an installed capacity of about 21.6 lakh tons. About 65% of the installed capacity is represented by large mills. Some developmental aspects of the Indian Paper Industry have been highlighted recently[1—3]. The industry is afflicted with a variety of problems including unsatisfactory position of power and raw material supplies. Paper industry is an energy intensive industry. Efficient mill operations are the need of hour.

A recent study by the Energy Committee[4] shows the existence of a wide variation in energy consumption and other inputs among different paper mills. For example, energy requirements of large mills vary from 7.5 to 13.25 million K cal/tonne of paper produced. In small paper mills the energy consumption is found to vary from 5 to 10 million K cal/tonne of paper[5]. The steam consumption for large mills varies from 10.5 to 17.4 tonnes per tonne of paper and the electric power consumption from 1305 to 1449 KWH. The amount of on-site power generation at some large mills varies from 25 to 60% of the total power requirements. This would indicate a great scope for energy consumption by better house keeping, preventive maintenance and improved operational plant efficiency.

About 35% of the existing capacity is accounted by the small paper mills. The mill capacity varies from 2000 to 20,000 tonnes per annum. A typical small mill may use on an average 55% agricultural residue and bagasse, 40% waste paper, 5% purchased pulp and other long fibre material such as cotton linters, rags etc. Being the residue of an annual crop, the supply of agricultural materials at low cost is assured. Moreover, small mills using non-conventional raw materials enjoy excise concession. Hence, most of the capacity added during the past 5-6 years are based on agricultural residues. Considerations of the demand projections indicate that the existing capacity must be doubled by the turn of century. As per the already set trend, most of the new capacity must necessarily be based on the non-conventional raw material source.

## BAGASSE, A PROMISING RAW MATERIAL

A number of recent reports[6—9] indicate bagasse to be an ideal raw material for paper manufacture. There are over 330 sugar mills in operation currently. An estimated 65 million tonnes of sugar cane may be crushed during the season to produce about 20 million tonnes of mill wet bagasse containing about 50% moisture. About 5.5 tonnes of mill wet bagasse are required to produce one tonne of bleached pulp. Thus, about 3.7 million tonnes of paper may be produced if all the bagasse is made available to paper mills. This would be about 3 times the present consumption of paper the country. However, the avail

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ability of bagasse for paper making is restricted mainly due to its principal use as fuel for boilers in sugar mills. Only surplus bagasse can be spared for paper production. By improving the thermal efficiency of the bagasse fired boilers and by operating sugar mills at optimum production levels, about 10-15% of bagasse may be saved and released for paper manufacture. Even if this entire surplus bagasse is diverted for paper production, about 4 lakh tonnes of paper may be produced which would be about 33% of the present consumption.

Sigh and Paul[6] have shown that, with the suggested technology improvements for bagasse drying and bailing facilities, a cluster of sugar mills could create a potential and dependable source for paper mills as ancillary units. Murlidharan[8] discussed the case study of Tamil Nadu News Print and Paper Limited who have entered into firm agreements with six sugar mills situated within a distance of 150 KM from the mill site. Another example is the setting up of a sugar mill by M/S. Ponni Sugars and Chemicals Ltd. adjacent to Seshasayee Paper Mills. The paper mill would supply steam and provide other infrastructural facilities to the sugar mill to obtain the entire bagasse in exchange. Ramalinga Setty et al[9] have described the useful experience at Mandya National Paper Mills along with details on techno-economics of a paper mill based exclusively on bagasse.

## PARALLEL UNITS IN A PAPER COMPLEX

It becomes abundantly clear from the above discussions that bagasse is emerging to be an importaut raw material for paper production. With judicious efforts substantial amounts of bagasse can be released for paper mills. It is for this reason that as an incentive for industry the Government of India have announced a 100% excise rebate on paper made out of a furnish containing not less than 75% bagasse pulp.

The Energy Committee report[4] observes that bagasse and agricultural residues as raw material have the advantage of comparatively low consumption of chemicals for cooking and bleaching and lower energy consumption. Thus, from energy conservation and other cost savings view point, it will be desirable to put-up a sugar mill at the existing or a new paper mill. Mysore Paper Mills, Bhadravati, have rightly taken a lead in this direction by setting up a sugar mill of their own to obtainbagasse for the existing paper mill. Further, with the process heat to power ratio at about 80:20, the paper industry is very well suited for captive power generation. A paper-sugar mill combination would make cogeneration as an attractive proposition.

## PAPER - SUGAR - ALCOHOL-COMPLEX

Photosynthesis is one of the most efficient natural conversion process of solar energy and the sugar cane plant holds a unique position in the family of all annual crops. This is the only crop which is endowed with one of the highest solar energy conversion efficiency for biomass and can be rightly named as a vast store-house of fibre, food, fuel, fertilizer and chemicals. One hectare of land can annually produce about 10 tonnes of valuable fibre for paper, 10 tonnes of food products including sugar, a Kilo-litre of alcohol and 2 tonnes of fertilizers provided this raw material is processed in a more efficient manner. Sugar cane has been traditionally processed for recovery of crystallized sugar and the emphasis on recovering the last trace of this product has been so intense that expenditure of energy had never been a primary consideration right from the first stage of juice extraction at sugar mills upto the last stage of molasses. This inherent shortcoming of conventional processing technology with overemphasis on sucrose extraction has been realized only recently. With an integrated sugar mill and a distillary unit, the proportion of sugar and alcohol can be altered as and when desired. High purity primary juice can, thus be used for sugar extraction and low purity secondary juices and molasses obtained from any appropriate stage can be utilized for producing alcohol. This scheme enables minimum energy inputs, generation of substantial surplus bagasse and additional valuable energy source in the form of ethyl alcohol. Spent wash of distillary along with municipal waste of workers colony and mill effluents can further be used for bio-gas generation which can be utilized for meeting energy needs to suit local conditions. This alternative to the conventional sugar cane technology requires minimum of steam and power consumption.

## COMBINED UNITS HAVE BECOME IMPERATIVE

Highly unremunerative prices offered to the farmer has made sugar cane cultivation unattractive. Consequently, the area under cane production tends to decrease and the sugar mills are unable to obtain adequate supplies of cane for crushing. This has adversely affected their performance. Most of the sugar mills are under great financial constraints on account of poor supplies of cane and other controls on the sale of their products. It is a vicious circle and the only remedy in sight for the industry

appears to be to disversify and to set-up parallel units as suggested above. A combination of a paper-sugar and alcohol unit may be ideal. Bagasse will be used for paper production and molasses will be captively consumed for alcohol production. Under Government control, molasses is sold at highly unremunerative price. Thus. setting-up of the proposed Paper -Sugar complexes has become imperative. The performance of the combined units will be impressive. It may then be possible to offer remunerative prices to the farmer for can supplies and motivate him to increase can production.

## ADD A STARCH UNIT

Maize starch is an agro-based industry. Suppose a maize starch unit is also attached to a Paper-Sugar mill combination. Sugar production is a seasonal industry and works for 5 6 months in a year. The sugar mill remains idle for the rest of the period. However, in a complex, while sugarMill would be operated during the cane season, the paper and starch unit would operate through out the year. Interestingly, some of the equipment and utilities such as boilers, electric installations, centrifuges, material handling equipment, water storage and treatment units, a maintenance shop, a quality control and testing laboratory, storage space for raw meterials and products may be common facilities. Such a complex would support a central power plant from the steam turbines of which low pressure steam may be utilized for process heat. Further, it is important to note that a large number of key personnel such as the technical, the administrative, the sales and the finance groups may also be common for the entire complex. Thus, a combination of the above unit should lead to great savings in initial investment costs.

## VALUABLE BY - PRODUCTS REDUCE PRODUCTION COSTS

The by - products of sugar industry are bagasse, molasses and wax from filter mud. Bagasse will be used for paper production and molasses for alcohol production. Wax is a valuable product. The by-products of maize processing are highly valuable. Maize oil is among the best edible oils known so far. Any quantity of Maize oil produced will be a boon to the society. Oil cake, gluton, maize bran and steep concentrate are rich in protein and mineral matter. These products are use ful ingredients of animal feeds and are in great demand. Steep concentrate is particularly important for its use in the production of the life saving drugs such as pencillin, streptomycin etc. Thus, the realization of by products from the complex should result in overall lower production costs.

## A MULTIPURPOSE AGRO-BASED COMPLEX

Cellulose, Cane sugar and starch belong to the family of polysaccharides. Hydrolysis of cellulosic materials under certain conditions results in the formation of fermentable sugars[10–12]. Starch, dextrose and their derivatives are a potential source of a large number of organic chemicals[13–16]. For example, dextrose derived from starch may be converted to sorbitol, glycerol and ethylene glycol[16]. A host of other products of industrial importance may be derived from dextrose[14–15]. Sorbitol is used for the manufacture of vitamine 'C' which is in great demand. The production of a large number of products from bagasse, from molasses and hydrol (mother liquor obtained from dextrose production) are economically attractive. Ethyl alcohol obtained from molasses, agricultural Wastes and other fermentable materials such as starch and its derivatives, opens up a good scope for a large number of synthetic organic chemicals presently being produced from petroleum products. A distillary and a host of ethyl alcohol based synthetic organic chemicals may form a part of the down-stream units. An animal feeds plant may be as an integral part of the main complex. A captive power plant will make the complex independent in all respects.

## CONCLUSIONS

It emerges from the above discussions that additions of a sugar mill, a distillary and a starch unil to a tradittional paper mill would prove extremely advantageous. Substantial energy/cost savings with resultant lower costs of production of paper, sugar, starch and their derivatives may be realised. Techno-economic studies for the proposals of a combined sugar and paper mill and a sugar-cum starch plant were undertaken. The findings were highly encouraging[17–18]. A news report[19] about the establishment of a sugar-alcohol-paper complex in Tamil Nadu shows a pioneering step in this direction,. It is also heartening to note that one large paper mill in South India has set-up own sugar mill with the primary aim of obtaining bagasse for paper production. News about cogeneration of electric power at a sugar mill is indeed welcome.

When implemented the proposed integrated agro-based paper -sugar-starch complexes are likely to prove far more important to the national industrial

economy in the near future than the present-day petrochemical complexes bassd on irreplenishable petroleum reserves. A concerted planned effort in this direction will be in the national interest.

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