

A versatile raw material untapped

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If trees have been held in reverence from time immemorial, it is rightly so, as large clusters of trees create forests which are considered the lungs of the society and are vital for the climate and environment. Forests also fulfil man's needs for food, fuels, fodder, building materials, medicaments etc. besides being guardians of soil and water. They are of immense importance in controlling soil erosion, protection against floods and conservation of water supplies. More than anything else, trees participate in the oxygen cycle, converting carbon dioxide and water from the atmosphere to food and oxygen. It has been estimated that a full grown tropical tree releases about 1 tonne of oxygen per day utilising about 1.2 tonne of carbon dioxide in the process. Since oxygen is absolutely necessary for breathing for man or for a furnace, the importance of green leaves of trees in maintaining oxygen balance of the atmosphere is paramount.

The necessity of the tree cover, which is dwindling very fast, need not be over emphasised. While the reported forest cover in India is about 22.8% of the total geographical area, the actual tree cover, as confirmed by satellite pictures, is hardly 12% and is alarmingly low. Efforts are being made to increase the tree cover in the country. But the increasing needs for fuel, fodder and industrial needs are also hindrance in the afforestation programme. Planning of utilisation of water and degraded lands by creating two National Boards is a step in the right direction.

Environment has been defined "as the sum total of all conditions and influences that affect the development and life of organisms". Forests and eco-system are very intimately connected. Forests consist of living communities of trees, shrubs, ground flora and fauna. Various forest types represent different eco-systems. Environment has a direct relevance to the living beings

inhabiting the planet and also called "Biosphere". Biosphere is the thin layer of soil, rock, water, and air that surrounds the planet earth on which we live. The biosphere also consists of living organisms and their non-living surrounding closely inter-related and is made up of a large number of big and small ecological systems powered by solar energy. These eco-systems are the basic life support systems on this planet. These systems have to be conserved, scientifically managed, developed, not only for the present but also for future generation.

Wood is the principal raw material for the production of pulp and paper around the world and non-wood materials such as straw, sugarcane bagasse and bamboo account for only about 6% of world production. The forest based fibrous raw materials such as softwood, hardwood and bamboo are being extensively used in paper industry as a result of which shortage of these conventional raw materials are creating a problem for the growth of the paper industry, specially in India. Also, to stop deforestation for ecological reasons and to meet the ever increasing demand of pulp and paper, the search for a suitable unconventional alternate fibrous raw material is needed. Agricultural residues like straw (wheat and rice), bagasse, grass (sabai, sarkanda, kahi), kenaf, jute waste etc. are being used in pulp paper industry. But all these have their merits and demerits. Straw is an important fodder. The availabilities of grass, kenaf, jute waste are limited vis-a-vis estimated demand of paper at 28.60 lakh tonnes during 1995-96 and around 37.9 lakh tonnes by 2000 A.D. Use of bagasse for the manufacture of newsprint and also for quality writing printing paper is now a success story and its potential is vast.

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Sugarcane is a raw material with remarkable characteristics that make it the commercial plant with the highest yields of green matter, energy and fibre, obtained in a shorter cycle than any other species of plants.

Under average cultivation care, sugarcane can produce 100 tonnes of green matter per hectare, that expressed in terms of energy, represents 1,000 tons of oil due to its great capacity for fixing energy through photosynthesis and its potential for growing in climates and soils in which other crops do not.

AMOUNT OF PRODUCTS THAT CAN BE OBTAINED FROM 100 TONNES OF HARVESTED SUGARCANE

PRODUCTS	TONNES
Sugar	10.0 — 12.0
Bagasse (50% moisture)	30.0 — 33.0
Final molasses (88° BRIX)	3.5 — 4.0
Filter mud (77% moisture)	3.5 — 4.0
Green leaves	7.8
Dry leaves	6.9
Cane tops	6.9

Bagasse has been used as fuel since the first half of the nineteenth century, when steam engines began to be used widely at sugar mills. Bagasse, a product obtained from the last tandem roller, is comprised of particles of an average size of approximately 2.5 mm having the following components with the respective approximate percentages given alongside :

Fibre bagasse	45%
Insoluble solids	2—3%
Soluble solids	2—3%
Water	50%

In grouping the fibres of the cortex and the short fibres inside the stalk into a single portion referred to as fibre of useful fibre, there is another portion made up of the pith, and a third, comprised of fines, soil and solubles.

The fibre content of whole bagasse is approximately 60% and that of pith accounts for approximately 40%.

Bagasse is composed of cellulose, hemicellulose and lignin, as its main natural polymers. It also has small accounts of other components, generally classified as foreign matter. Experiments have established that the chemical composition and morphological components of bagasse are not affected to a great extent by the variety of sugarcane. Cellulose is the main component of the cellular wall of all plants, which appears in its most pure natural form in cotton, although cellulose is also present in other fibre sources, such as wood, Insolubility in water, organic solvents and alkaline solutions, in addition to its resistance to the effects of oxidising agents, distinguish cellulose from the rest of the chemical components of wood.

Chemically, cellulose is defined as homopolymer of D-glucose, whose main link to the other units in the chain is of the B 1—4 type. The molecular weight of bagasse cellulose averages within a range of 150,000 and 350,000. From the quantitative perspective, its presence is similar to that of all woods, within a range of 41 to 44%.

Hemicelluloses cover a series of well-characterised polysaccharides, whose composition has the common characteristics; they are soluble in solvents, react to acids, and are decomposed to sugars and furfural. These properties distinguish them analytically from the other chemical components of bagasse. The hemicellulose that is predominant in bagasse is of the D. xylane type.

The polymer chains are short, the average viscometric molecular weight are within a range of 10,000 to 20,000 and the proportion is from 25 to 27%. Lignin is the third most important of bagasse in so far as quantity is concerned — from 20 to 22% and includes a series of amorphous, reticular polymers with a high molecular weight and basically of phenolic nature.

It has been estimated that the energy demand of a sugar mill may be met with nearly half of the bagasse it produces with certain measures which leave a surplus for use as raw material for paper. Within this alternative, it is worthwhile that the bagasse be depithed to the greatest extent possible at the sugar mill, so that

the pith may be used in the boilers and the fibrous portion delivered to the derivatives industries. However, the use of bagasse in user industry will depend on the cost and characteristics of the product, the transportation, depithing and storage facilities etc.

This versatile raw material is yet to be fully tapped in the country except in newsprint in a small way.

At present, our sugar mills save only 5—6% bagasse on the average after meeting their energy requirements. In some cases, it is more and in some cases even it is nil. With better management and some measures, the saving could be easily 15%. As indicated earlier, bagasse generation is

approximately three times than that of sugar production. A saving at 15% could generate a surplus bagasse of 5.4 million tonnes. At 1 : 6 norm of consumption, this is equivalent to 9 lakh tonnes of pulp, which cannot be ignored.

Greening of the mother earth is a necessity for our continued existence in the black immensities of the universe. We are also in the space where life exists. There should be absolutely no cutting of trees for paper or anything else. The Indian Pulp and paper Industry must not overlook the immense quantity wise potential of bagasse as a raw material.