Abstract

The sugar industry is one of the most important industries in India next to cotton textiles. In recent times, the profit derived from the manufacture of sugar has been steadily declining due to economic and socio-political reasons. It is realized that more avenues to earn profits need to be established through proper and full utilization of its by-products. The Indian sugar factory has emerged as the leader in the sugar world, both in respect of sugarcane and sugar production. However, it is facing many constraints, which have endangered its viability. The situation, therefore, calls for proper and judicious utilization of the various by-products and co-products and developing allied industries with the sugar industry as the core industry. The main by-products of the sugar industry are – (i) bagasse, (ii) molasses and (iii) filter cake or press mud. In India sugar is manufactured by the application of either double sulphitation process or by double carbonation process. Due to impact on ecological balance of nature, carbonation process has become redundant. Hence almost all sugar factories at present follow double sulphitation process. Only a few sugar factories follow phospho floatation process. Normally, the press mud obtained during manufacture of sugar by double sulphitation process is about 3-5% on cane where as the press mud obtained by double carbonation process is around 5 to 8% on cane crushed. The sulphitation press mud is more useful as a manure due to its nitrogen, phosphate and potash content. The carbonation press mud due to alkalinity has not been found useful. The wax content of press mud has got some detrimental effect on soil porosity on its direct application in field. It has been observed that wax free press mud is more useful for farmers cultivation.
In India first wax plant was started at Ravalgaon Sugar Farm Ltd., in 1949 employing batch extraction process. However, due to certain unavoidable circumstances, this plant has stopped its operation. In addition to this, another plant worked in India for about five years i.e., the K.C.P. Ltd., Vuyyuru, Andhra Pradesh. This plant was also stopped for quite some time on account of non-availability of suitable market for the same. This plant reportedly has again started its wax production but market demand is yet to be developed for its survival.

Hard wax is considered to be a very important property of wax and it determines its suitability for application in the industry for making polishes, carbon paper, printing ink, electrical insulating agents, photographic preparations, cosmetics and flame proofing agents etc. This is particularly true, if waxes possess also the properties of easy emulsifiability and good oil retention capacity. The crude wax obtained from sugarcane press mud is having low melting point as also low solvent retentivity property. Due to lack of these two important properties, crude wax extracted from sugarcane press mud could not find its industrial application which resulted shutdown of wax extraction units in India and abroad. Experiments so far conducted have shown possibility of making hard wax with industrial properties but no experiment has shown possibility of making crude wax containing soft and hard wax together (without separation of soft wax from the hard portion) of good quality industrial wax. This is evident from the inference of one of the Research Scholars as under- “No process yet devised which can produce waxes from crude wax comparable to carnauba wax and I.G. wax in hardness, melting point and gelling properties. In order that sugarcane wax may replace carnauba and other hard waxes, it is essential that it may be subjected to further modification after refining”. 
Normally, sugarcane wax obtained from press mud is a mixture of soft and hard wax. Due to softness of the wax it has not been found suitable for direct industrial application. Moreover, separation of soft wax from the crude sugarcane wax is not found economical. As such, the present author has endeavoured to modify the crude wax chemically without separating soft wax to such an extent that it can substitute any other hard wax available in the market for its commercial application. This would not only be a boon to the Indian sugar industry but it will also be a boon to the world sugar industry as a whole. The impact would be that the import of commercial wax from other countries could be reduced to a great extent and huge amount of foreign exchange could be saved.

The thesis consists of eight chapters. The first chapter consists of introduction and scientific background/mechanism of wax formation in cane. In this chapter the role of nature in the formation of wax in sugarcane as also distribution of lipids, oils and fats have been described. In addition, Chemical compounds in waxes, wax hydrocarbons, alcohols, acids, esters, sterols, composition of semi-refined sugarcane wax have also been mentioned.

In the second chapter, historical background of extraction of wax from sugarcane press mud by the application of various solvents, their molecular formula, specific gravity, boiling points, extraction process, temperature of extraction, extraction equipment, characteristics and composition of sugarcane wax have been described.

In the third chapter, wax content in sugar cane as also views of different authorities on the chemical composition of wax have been mentioned.
In chapter four, review of work done for making crude sugarcane wax to an industrial quality wax has been mentioned.

In chapter five, review of work done on chemical modifications of sugarcane wax such as ester wax, amide wax, anilide wax etc. has been described.

In chapter six, a new process has been developed by the author chemically modifying the sugarcane crude wax. The unique advantage of this process is that the crude wax as a whole is chemically treated without separating the soft wax and hence it is more economical. Moreover, the modification has been carried out keeping in view the necessity of having almost all the desirable qualities of an industrial quality wax like that of carnauba wax. Possible mechanism of reaction between phthalic anhydride and glycerol wherever possible has been indicated. Various observations have been outlined on the basis of difficulties encountered at the time of conducting experiments along with the precautionary measures required to be adopted to overcome such problems to achieve best possible results.

In chapter seven procedures adopted for determining various constants with accuracy have been described.

In chapter eight, some useful tables of physical constants of waxes have been incorporated (for theoretical interest) for facilitating the interested scientists likely to carryout research in the field of wax in near future.