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WASTE TO WEALTH FROM SUGAR INDUSTRY

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Abstract : Waxes have important specific properties for food and cosmetic uses, and for cleaning and polishing applications. The knowledge of the characteristics of waxes is essential for their application. Wax recovered from sugarcane (Saccharum officinarum) filter cake, a by-product of the sugar and alcohol industry, represents a potential alternative to carnauba, beeswax, and synthetic waxes, considering the enormous resources of raw material in sugarcane growing countries. Crude wax solvent extraction and fractionation were studied in this paper.Filter cake extracted with Benzene yields 6 to 7 % crude sugarcane wax. Purified sugarcane waxes presented analytical indexes similar to those of commercial bee and carnauba waxes.

Keywords: Sugarcane wax, Extraction, Press mud, Benzene

Introduction-

Sugar cane (Saccharum officinarum L.) is one of the industrially important crops mainly grown in Brazil and India. India has just over 500 sugar mills, with nine states (Uttar Pradesh, Bihar, Punjab and Haryana in the northern region; Maharashtra & Gujarat in the western region and Andhra Pradesh, Tamil Nadu and Karnataka in the southern region) holding 95 % of them. Most mills are either privately owned or co-operatives

The global production in the year 2009 was reported to be 1900 million tones of which India produced 285 million tones accounting for 14.9%. In India, sugarcane supports one of the largest agro-processing industries and more than 6 million farmers are engaged in its cultivation. According to the Indian Institute of Sugarcane Research (IISR) Vision 2030 report, India is expected to increase sugar cane production to 520 million tones.

Sugar industry has many by-products like bagasse, molasses, press mud, and leaves (trash) Sugarcane bagasse is the fibrous residue of sugarcane (Saccharum officinarum) after the extraction of juice. Bagasse, as agro-based fibers, have the composition, properties and structure that make them suitable for uses such as composite, textiles, pulp and paper manufacture and animal feed, among others. In addition, bagasse biofibers can also be used to produce fuel, chemicals, enzymes and food and is one of the most relevant sugarcane by-products of the cane sugar production industry, a mixture of hard fiber, with soft and smooth parenchymatous (pith) tissue, having high hygroscopicity, soil, wax, residual sugars, etc., remaining after the cane has been crushed and extracted the juice.

Press mud from the sugar mills is a very useful source of fertilizer as well as some chemicals. The major use that has recently been developed in India is in bio composting (usually trade named as Bio earth) where it is treated with the spent wash from the distillery. The composition of press mud is given in Table 1. Its usefulness as fertilizer is based on the nutrient content of the mud and the spent wash as shown below:
Press mud – N- 1.15 to 3.0%; P- 0.60 to 3.50% and K- 0.30 to 1.80%.
Spent wash – N-2630 mg/l, P-20 mg/l and K-222 mg/l

Composition of press mud:

Crude wax	5-14%
Fiber	15-30%
Crude Protein	5-15%
Sugar	**5-15%**
SiO	4-10%
CaO	1-4%
PO	1-3%
MgO	0.5-1.5%
Total ash	9-10%.

Benefits:

1. Very low power requirement.
2. Zero discharge to inland water resources and freedom from river or ground water pollution.
3. Organic fertilizer produced is rich in micronutrients and can reduce the requirement of chemical fertilizers. It also provides bacteria for nitrogen fixing, solubilisation of phosphates, humus that will keep the soil healthy and develop the self-reclamation cycle.Since bio composting is accompanied by a rise in temperature, chances are that the fertilizer is free from all pathogens, harmful bacteria, weeds and seeds. Fertilizer is free flowing, easy

to handle, to pack and transport.

The bio compost contains 25-30% organic carbon, 1.2-2.0% nitrogen, 1.5-2.0% phosphorous and 2.5-3.0% potash.

The shortcoming of this operation is the limited period of operation of sugar plants. The press mud has to be stored in large open areas and large lagoons are to be set up to store the spent wash. However, the long-term effects of application of this fertilizer remain to be studied.

Sugar mills produce a range of by-products, including bagasse, filter mud and molasses. A typical sugarcane complex with a capacity of 3,000 tonnes crushed per day (TCD) can produce 345 tonnes of refined sugar, 6,000 litres of alcohol, 3 tonnes of yeast, 15 tonnes of potash fertilizer, 25 tonnes of pulp, 15 tonnes of wax, 150 tonnes of press-mud fertiliser12 and 240MWh of exportable electricity from bagasse.

Press mud like other organic materials affects the physical, chemical and biological properties of soil2. However, due to its bulky nature and wax content it causes some problems. If press mud is directly applied to soil as manure, the wax present might deteriorate the physical properties such as permeability, aeration, soil structure and composition etc. and with the passage of time the deterioration might get worsen. Therefore,

extraction of wax from press mud will be helpful to enhance the quality of press mud as organic manure.

Solvent Selection:

The solvent is the key to a successful separation by liquid-liquid extraction. The several criteria are:

Distribution Coefficient

This is the ratio (at equilibrium) of the concentration of solute in the extract and raffinate phases. It gives a measure of the affinity of the solute for the two phases. A distribution coefficient other than unity implies that the solute must have different affinity in the two phases. If only one solute is involved (such as in the recovery of an impurity from an effluent stream), only the distribution coefficient need be considered, and it is desirable for this to be as large as possible.

Selectivity (Separation Factor)

If there are more than one solutes (say two solutes A and B), then consideration should be given to the selectivity of the solvent for solute A as against B. The selectivity between the 2 solutes A and B is defined as the ratio of the distribution coefficient of A to the distribution coefficient of B. For all useful extraction operation the selectivity must exceed unity. If the selectivity is unity, no separation is possible.

Insolubility of Solvent

The solvent should have low solubility in the feed solution; otherwise the separation is not "clean". For example, if there is significant solubility of solvent in the raffinate stream, an additional separation step is required to recover the solvent.

Recoverability

It is always necessary to recover the solvent for re-use, and this must ordinarily be done by other means, e.g. distillation. If distillation is to be used, the solvent should form no azeotrope with the extracted solute and mixtures should show high relative volatility. The solvent should also be thermally-stable under the distillation temperature.

Density

A large difference in density between extract and raffinate phases permits high capacities in equipment. This is especially important for extraction devices utilizing gravity for phase separation.

Interfacial Tension

The larger the interfacial tension, the more readily coalescence of emulsions will occur but the more difficult the dispersion of one liquid in the other will be. The more readily coalesces the emulsions the easier phase separation will be. Low interfacial tension aids dispersion and thus improves contacting mass-transfer efficiency. Coalescence is usually of greater importance, and interfacial tension should therefore be high.

Chemical Reactivity

The solvent should be stable chemically and inert toward the other components of the system and toward the common materials of construction.

Viscosity, Vapour Pressure, Freezing Point

These should be low for ease in handling and storage, for example, a high viscosity leads to difficulties with pumping, dispersion and mass-transfer rate.

Availability and Cost

An excellent solvent may not be commercially available. Or it may represent a large initial cost for charging the system, and a heavy continuing expense for replacing inevitable operating losses.

Other Criteria

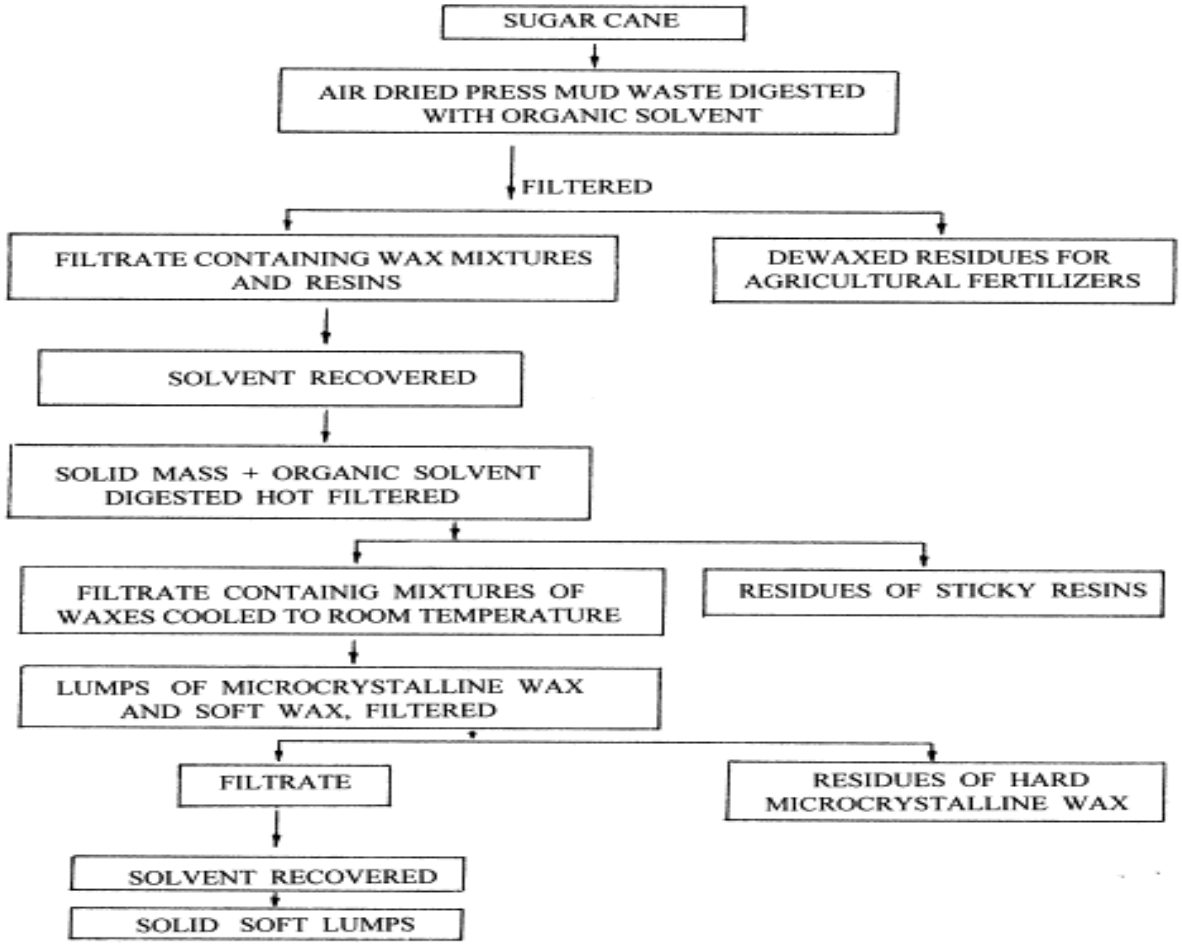
Toxicity and flammability of the solvent are important occupational health and safety considerations. Stability of the solvent (i.e. resistance to breakdown), particularly in the recovery steps, is significant, especially if the breakdown products might contaminate the products of the main separation. Corrosivity of the solvent leads to the usual problems with materials of construction. Finally, compatibility of the solvent with the mixture to be separated can have many manifestations, particularly when easily contaminated materials such as food or pharmaceuticals are being handled.

-It should be non-toxic and selective, i.e. it should dissolve only the required constituent with minimum amount of the inert materials.

- It should not cause the extract to complex or dissociate.

-It should be preservative in action.

-It should promote rapid physiologic absorption of the extract.
- It should be easily evaporated at low heat



The process of the present invention is being further illustrated by the following practical examples which should not, however, be construed to limit the scope of the invention.
- Collection of press mud from sugar industry.
-Kept for drying in open atmosphere.
-Extract wax from press mud by using Benzene, Toluene as solvent in soxhlet extractor up to 6 hours. Organic solvent extraction is the most common and most economically important technique for extracting aromatics. There are different solvent used for extraction of wax but pure toluene is excellent oil solvent and has good solvent power for wax extraction as well. A crude wax extracted with benzene was used for the entire investigation. A further consideration was that benzene extraction appeared most feasible for commercial scale production.
-Collect extract from soxhlet extractor and kept it for filtration unto 3 to 4 hours.
-After filtration put the solution for distillation process.
-Collect the benzene as distillate, and wax remains at the bottom of round bottom flask.
- Collect the wax from round bottom flask.
-Add isopropyl alcohol in wax for removal of resins from wax.
- After removal of resins wax is formed
Specifications:

Table No.2: Specifications of wax

Item	Index
Acid Value	6-26
Saponification Value	50-150
Iodine Value	22-24
Melting Point	76-82^{0}c
Color	Brownish black/Light yellow

Sugarcane wax, a whitish to dark yellowish coating on the surface of sugarcane, gets extracted and separated along with press mud during crushing and processing of the cane juice. This wax portion finds applications in cosmetics, paper coating, textiles, fruit and vegetable coating, leather sizing, lubricants, adhesives, polishes, and pharmaceutical industry Thus, it can be considered as an alternative to costly carnauba wax, candelilla wax, and chitosan for edible coating applications. Sreenivas et al. found ash gourd peel a good source of wax which was used as edible coat for strawberries to enhance their shelf life. The overall crude wax has several industrial uses which include the

coating of steel products for metal working and rust prevention while for uses such as polish production refinement of the crude wax into its fractions is necessary.

Applications:

The refined variety of the hard sugarcane wax having its potential use in:

1. Foodstuff industry: can be widely used as the coating and brightening agent of making gum confection, chocolate products and processing fruits;
2. Cosmetic industry: can be used for making brilliantine wax, lipstick, puff cake and eyebrow pencil.
3. Brightening agent: to be widely used for making shoe polish, glazing wax for vehicles and to make shoes;
4. Other industry: to be widely used for making electrical wire, cable, explosive packing, carbon paper and moisture-proof paper, etc.
5. Medicines,
6. In sweet meats and pastries,
7. In tinned food products,
8. In castings and recordings,
9. In carbon papers,
10. In preparation of carbonless carbon papers,
11. In electrical insulation of cables and wires,
12. in preparation of various types of paints, varnishes and polishes including shoe polishes, car polishes and floor polishes, preparation of coloured pencils, crayons, water and oil paints,
13. In cosmetics
14. In preparation of emulsion paints for spraying.

In fact, it has its most likely entries into all the branches of industries where carnauba wax is mostly used. In bulk also it can be produced many times more than any other plant waxes combined together. The raw material, press mud is a rejected waste material of sugarcane industries that causes the unwanted problem of pollution to the surrounding supurbs of the sugar mills on accumulation. Also, the availability of the press mud is no problem at all throughout the year. While carnauba plant is a seasonal plant that produces extractable waxes only in marked period of a year

Conclusion

Press mud is a byproduct of sugar industries. Sugarcane press mud is easily available and cost effective than other sources of wax. The yield of wax found from benzene solvent was 6.% - 7 %. The color of crude wax was brownish green while the pure wax was light yellow in colour Extraction of wax from press mud was carried out with Benzene was within time of 6 hours hence it is a less time consuming process. These waste products are used as fertilizer in the agriculture field, but the presence of sugar cane wax in press mud deteriorates the physical property of soil and therefore the extraction of wax is necessary. This extracted wax has several applications in various industries which can bring products in national and international market. This study revealed presence of many classes of compound like alkane, ester, alcohol, fatty acids and so forth present in sugarcane press mud wax. The major component of wax i.e. sec-butyl isothiocyanates which has many beneficial effects can be utilised for medicinal purpose and can be used as a flavouring agent in lipstick. Apart from medicinal semio chemical and nutritional applications, wax can be used in food preservation as an edible coating for fruits and vegetables. Thus,sugarcane wax has many compounds of biological and industrial importance.

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