

STUDIES ON EXTRACTION OF SUGARCANE WAX FROM PRESS MUD OF SUGAR FACTORIES FROM KOLHAPUR DISTRICT, MAHARASHTRA

Bhosale P. R., Chonde Sonal G. and Raut P. D.*

Department of Environmental Science, Shivaji University, Kolhapur, Maharashtra (INDIA)

*Email : drpdraut@yahoo.co.in

: pbhosale849@gmail.com

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ABSTRACT

Press mud is a rejected waste material of sugarcane industries causes problem of pollution to surrounding of sugar mills on its accumulation. Present work deals with the development of method for the isolation and analysis of wax from press mud waste of the sugar industries from Kolhapur district. The crude wax is extracted by using toluene and benzene solvents and pure wax is obtained by giving treatment of isopropyl alcohol. The physico-chemical testing was carried out for characterization of isolated microwax. The yield of wax found from toluene solvent was 5.40 % - 5.60 % and from benzene solvent was 6.9 % - 7.4 %. The color of crude wax was brownish green while the pure wax was light yellow in colour. The Acid value, Saponification value and Iodine values were 4.99 - 5.95, 202.6 - 263.8, and 22.64 -29.27 mg/g respectively.

Key Words: Sugar industries, Press mud, Toluene, Benzene, Wax

INTRODUCTION

In India, Sugar industry with 400 Sugar factories rank as the second major agro-industry in the country. The sugarcane industry has several co-products of immense potential value. The co products include press mud (filter cake), molasses and spent wash. Out of which press mud is produced during clarification of sugarcane juice. About 3.6 - 4 % of sugarcane crushed end up as press mud i.e. 36 - 40 kg of press mud is obtained after 1 ton of cane crushing. Press mud is a soft, spongy, amorphous and dark brown material containing sugar, fiber and coagulated colloids including cane wax, albuminoids, inorganic salts and soil particles. It consists of 80% water and 0.9 - 1.5 % sugar, organic matter, nitrogen, phosphorus, potassium, calcium, sulphur, coagulated colloids and other materials in varying amounts. The time when cost of chemical fertilizer is skyrocketing and not affordable by farmers, press mud has

promise as a source of plant nutrient and as medium for raising sugarcane seedlings and leguminous inoculants¹.

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. Sugarcane wax has been chemically defined as a complex and variable mixture of long chain alkenes, hydrocarbons, fatty acids, ketones, aldehydes, alcohols and esters³ and steroids such as β -sitosterol, stigmasterol, ketosteroids and hydroxy keto steroids⁴. It is the whitish to dark yellowish powdery deposit on the surface of the stalks of the sugarcane, *Saccharum officinarum* L. During the milling

*Author for correspondence

of the cane, a large portion of this powdery substance is detached and mixed with expressed juice⁵.

MATERIAL AND METHODS

Collection of press mud

Sugarcane press mud waste were collected from four sugar industries from Kolhapur district namely Kumbhi Kasari S.S.K. Kuditre , Chatrapati Shahu S.S.K. Kagal , Chatrapati Rajaram S.S.K., Kasaba Bawada , Asurle -Porle S.S.K., Asurle Porle

Material

1. Soxhalet Extractor having 500 ml round bottom flask capacity was used for extraction of wax from press mud.
2. The solvents toluene and benzene were used for extraction of wax. Toluene has molecular weight 92.14 and assay (GC) 99%, and Benzene has molecular weight 78.11 and assay (GC) 99%
3. Isopropyl alcohol i.e. Propan-2-ol was used for purification of wax having weight per ml at 20°C is 0.783-0.786 gm and minimum assay by GC is 99%.

$$\text{Acid Value (mg of KOH/gm)} = \frac{\text{MBR} \times \text{Normality of KOH} \times \text{Eq. wt of KOH}}{\text{Wt of Sample}}$$

(b) For Iodine value, weighed sample is mixed with chloroform and Hanus iodine solution, sample is mixed properly with addition of KI solution then sample is titrated against 0.1 N Sodium thiosulphate in conical flask until solution turns into colourless. Repeat the procedure for blank. The calculation is carried out by formula.

$$\text{Iodine number} = \frac{(B-S) \times N \times 12.69}{\text{Wt of Sample}}$$

Where

B = mL thiosulphate for blank

S = mL thiosulphate for sample

N = normality of thiosulphate solution

4. Sugar cane press mud was collected from four sugar factories from Kolhapur district.

Extraction Procedure:

Sugar cane press mud waste was extracted with different solvent such as Toluene and Benzene under a reflux system for 4 - 6 hr at a stretch. The extract was filtered under mild vacuum and solvent recovered by distillation. After recovering the solvent the solid mass containing wax mixtures and resins thus obtained was dissolved in hot isopropyl alcohol and filtered. The resin portion was separated and the total wax portion obtained which was yellow or light cream in color.

Analysis of physico-chemical properties of wax

The Physico-chemical properties of wax were analyzed by Saponification, Iodine and Acid value, which were determined using standard methods of BIS⁶.

(a) In case of Acid value determination, sample is mixed with fat solvent + ml of phenolphthalein indicator and then this mixture is titrated against 0.1 N KOH until faint pink colour persist for 20-30 sec. Run the same without wax as a blank. The calculation was carried out by formula.

(c) For Saponification value, weighed sample is mixed with alcoholic KOH and boiled for an hour, then all the contents are titrated against 0.5 N HCl by addition of indicator until the pink colour just disappeared. Repeat the procedure for blank. The calculation was carried out by formula.

Analysis of physico-chemical properties of Press mud

The physico-chemical properties of press mud before and after extraction of wax were analyzed. It includes pH, Moisture content, Total Nitrogen, Phosphorus, Potassium, Organic matter, organic carbon, Calcium, Magnesium and C: N ratio. All the procedures were followed described in APHA².

$$\text{Saponification Value} = 28.05 \times \frac{\text{Titre value of blank} - \text{Titre value of back}}{\text{Wt of Sample}}$$

RESULTS AND DISCUSSION

Recovery of wax from press mud by using toluene and benzene

Toluene and Benzene have been used as a solvent for extraction of press mud for isolation of wax. Organic solvent extraction is the most common and most economically important technique for extracting aromatics⁷. There are different solvent used for extraction of wax but pure toluene is an excellent oil solvent and has good solvent power for wax extraction as well⁸. 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 production⁹. **Fig. 1** shows that the percentages of wax obtained from four sugar factories are different. The Shahu Sahakari Sakhar Karkhana showed 5.60 % of wax recovery from press mud by using toluene and with benzene it

showed 7.4% of wax recovery while Asurle-Porle showed 5.40 % of wax recovery by using toluene and with benzene it showed 7.3% of wax recovery, Kumbhi and Rajaram S.S.K. showed 5.46% and 5.55 % of wax recovery from press mud by using toluene and by using Benzene it showed 7% and 6.9% of wax recovery. **Fig. 1** show that the percentage of recovery of wax obtained from press mud by using Benzene solvent is more as compared to Toluene.

Physico chemical properties of wax extracted from press mud

Fig. 2 shows the Physico-chemical properties of wax mainly acid value, Saponification value and Iodine value. The acid number is a measure of the amount of carboxylic acid groups in a chemical compound, such as a fatty acid or in a mixture of compounds. Acid number indicates the extent of contamination of used oil or wax.¹⁰ The Acid value is an important indicator of

Table 1 : Yield of wax from Press mud.

S/N	Solvent	Kumbhi Kasari S.S.K	Chatrapati Shahu S.S.K	Chatrapati Rajaram S.S.K	ShriDatta AsurlePorle S.S.K
1	Toluene	5.46% \pm 0.05	5.60% \pm 0.04	5.55% \pm 0.15	5.40% \pm 0.21
2	Benzene	7% \pm 0.12	7.4% \pm 0.05	6.9% \pm 0.20	7.3% \pm 0.32

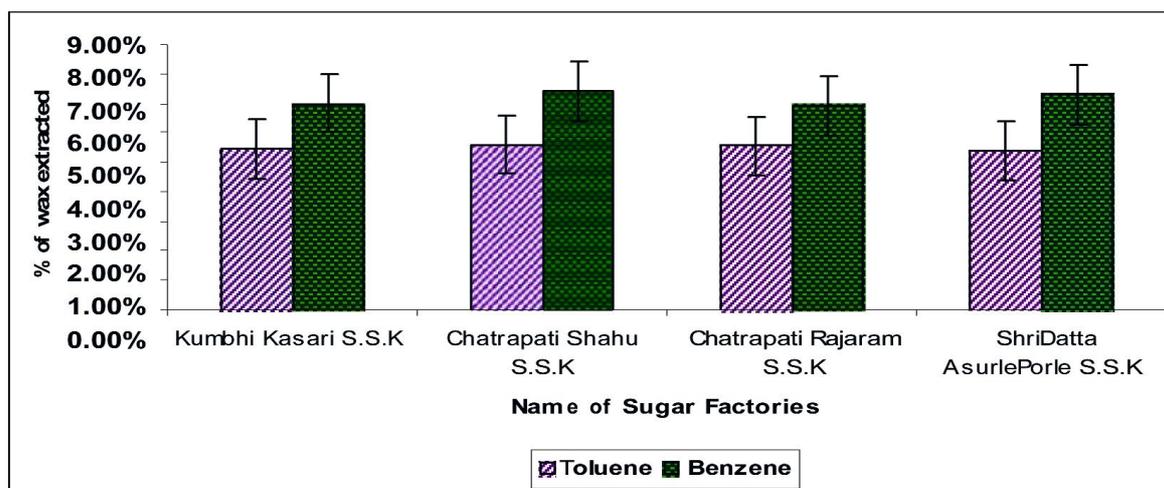
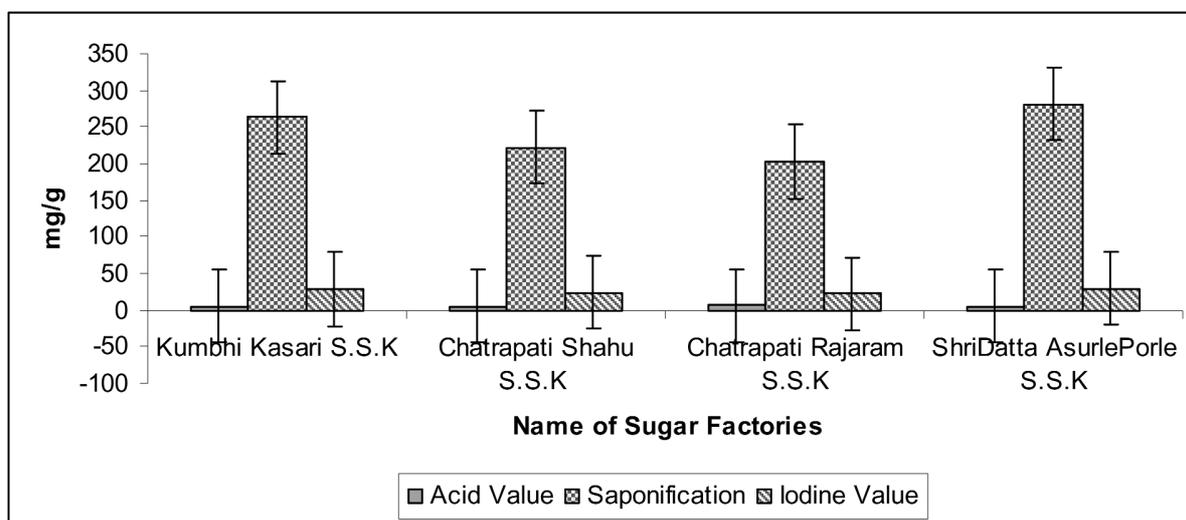


Fig. 1 : Yield of wax from different sugar factories

Table 2 : Physico- chemical properties of the wax from press mud waste of sugar industry.

S/N	Parameter	Kumbhi Kasari S.S.K. Mg/gm	Chatrapati Shahu S.S.K. Mg /gm	Chatrapati Rajaram S.S.K. Mg /gm	ShriDatta AsurlePorle S.S.K. Mg /gm
1	Acid Value	4.99 ±0.21	5.79 ±0.15	5.95 ±0.05	5.06 ±0.24
2	Saponification	263.8 ±0.35	221.9 ±0.50	202.6 ±0.23	281 ±0.25
3	Iodine Value	28.26 ±0.05	23.98 ±0.06	22.64 ±0.10	29.27 ±0.12

**Fig. 2 :** Chemical properties of the wax from press mud waste of 4 sugar factories.

quality of vegetable oil. The wax extracted from press mud of Rajaram S.S.K. shows high number of acid value, it is 5.95 mg/gm while the acid value of Kumbhi, Shahu and Asurle-Porle are 4.99, 5.79 and 5.06 mg/g of wax. The wax extracted from press mud of Asurle Porle showed high Iodine value, it is 29.27 mg/g. Iodine Number is a measure of the unsaturated fatty acid content and indicates the ease of oxidation or the drying capacity of the product. Fats and oils were selected to represent the wide range of lipid materials for which the determination of iodine value is of commercial importance¹¹. The iodine value of Kumbhi, Shahu, Rajaram S.S.K. press mud wax are 28.26, 23.98, 22.64 mg/g respectively. The determination of saponification value is a method used to

determine the number of acid and ester groups in a substance. It is particularly important parameter for users of oxidized waxes, as ester functionality determines the utility of wax as well as being a significant quality control test¹². Saponification number of wax extracted from press mud of Asurle Porle is 281mg/gm which are more as compared to other sugar factories such as Kumbhi Kasari, Chatrapati Shahu S.S.K and Chatrapati Rajaram S.S.K. which is 28.26, 23.98, 22.64 mg/g of iodine value. Over all Saponification value of all waxes are more as compared to acid value and iodine value. Sugarcane wax has always been a matter of interest, due to its industrial applications, in particular in the cosmetic and pharmaceutical industry¹³. It is a potential substitute for costly

carnauba wax widely used in cosmetics, foods and pharmaceuticals. In addition, sugarcane wax is also a source of long chain primary aliphatic alcohols, which find applications as cholesterol-lowering products¹⁴. Although wax is a potentially valuable by-product, extraction and processing costs are relatively high, leaving a rather small profit margin¹⁵. However, the new technologies can increase the viability of cane wax as a byproduct from press mud¹⁶.

CONCLUSION

Press mud is a byproduct of sugar industries. These waste products are used as fertilizer in 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. The proposed study will help to give idea about which solvent gives maximum extraction of wax as well as iodine value, saponification value and acid value. Considering the above aspects it is concluded that Benzene solvent gives maximum percent recovery as compared to Toluene by studying physico-chemical properties which are important indicator to test the quality of wax. In case of acid value of wax which reflects the amount of acidic impurities present in the wax which is very low as compared to the existing limits of up to 27.0 on most of the vegetable waxes indicating presence of impurities. Iodine value is ranging from 22.64 - 29.27 mg/g is much higher than ever reported in literature (4.0-15.0 mg/g). It appears as if some additional unsaturated material apart from the waxy esters might have been extracted out of the filter cake and this might be responsible in softening of the wax. The saponification value, which gives an insight into the amount of unsaturation present in wax, whereas the general range is indicating higher amount of wax esters extracted.

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