STUDY OF EFFLUENT FROM SUGAR CANE INDUSTRY

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MANUFACTURING PROCESS :-

These are two categories of sugar manufacturing process.

(i) Carbonation process. (ii) Sulphitation process.

Most of the sugar factories in India follows double sulphitation process and produce plantation white sugar.

The mavar unit operations are

(i) Milling (ii) Clarification (iii) Evaporation (iv) Crystalization (v) Centrifugation

(i) Milling—The cane received in the factory yard is fed to the cannier by mechanical un loader from tracks and trailers while the cane carts are manually emptied. The cane is passed through preparatory devices like knives for cutting the stalks in to fine chips before being subjected to crushing in a milling tundem comprising 4 to 6 there roller mills. Fine preparation with its impact on final extraction is receiving special attention and shredder and particularly the fibrizers are gaining popularity. The mills are of modern design, being equipped with turbine drive special feeding devices, efficient compound inbition system etc. In the best milling practice more than 95% of the sugar in the cane goes in to the juice this percentage being called the sucrose effraction or more simply the extraction. A fibrous residue called bagasse with a low sucrose content is produced about 25 to 30% of cane, which contains 45 to 55% moisture. This bagasse usually goes to the boiler as fuel and many factories use the bagasse for wallboard or paper manufacture, cattle feeding or other commercial by product utilization.

(**ii) Clarification—**The dark green juice form the mills is acidic (PH-4.5) and turbid, called raw juice or mixed juice. The clarification process, designed to remove both soluble and insoluble impurities, universally employs lime and heat as the deriving agents. The mixed juice after being heated to 65 to 75^0C is treated with phosphoric acid, sulphur dioxide and milk of lime for removal of impurities in suspension in a continuously working apparatus. The sulphar dioxide is generated by combustion of sulphur, while lime is either produced in kiln from lime stone or brought as such and stored in a separated house. The treated juice on boiling fed to continuous clarifier from which the clear juice is decanted while the settled impurities known as mud is sent to rotary drum vaccum filter for removed of unwatered stuff called process mud is discarded or returned to the fields as fertilizer. The clear juice goes to the evaporators without further treatment.

(iii) Evaporation -The clarified juice having much the same composition as the mixed juice, except for the precipilated impurities, removed by the clarification process contains about 85% coater. About 75% of this water is evaporated in vaccum Multiple effects consisting of a succeeding (Generally four) of vaccum boiling cells arranges in series so that each succeeding body has higher therefore boils at a lower temperature. The vapaours from one body can thus boil the juice in the next one by this system the steam introduced in on the first body does multiple evaporation. The vapours from the final body goes to condenser. The syrup leves the last body continuously with about 60% solids and 40% water.

(iv) Crystallization—The syrup is again treated with sulphur dioxide before being sent to the pan station for crystallization of sugar. Crystallization takes place in single effect vaccum pan, where the syrup is evaporated until saturated with sugar. At this point "Seed grain" is added to serve as a nucleus for the sugar crystals and more syrup is added as water evaporates. The growth of crystals continue until the pan is full given is skilled sugar boiler (or adequate instrumentation) the original crystals can be growing without the formation of additional crystals, so that when the pan is just full, the crystals, are all of desired size and the crystals and syrup or a dense mass known as "masticate". The "strike" is then discharged through a foot valve in to a crystallizer.

(v) Centrifugation—The masticate from crystallizer is drawn into revolving machines called centrifuges. The cylindrical "basket" suspend on a "spindle" was perforated sides lined with wire cloth, inside of which are metal, steels containing 400 to 600 perforations per square inch. The basket revolves at speed from 1000 to 1800 spm. The perforated lining retain the sugar crystals, which may be washed with water, if desired. The mother Liquor "molasses" passes through the lining because of the centrifugal fore exerted and after the sugar is "purged" if is cut down leaving the centrifuge ready for another charge of masticated. Modern installations are executive of the high speed type with automation control for the whole cycle. Low grades may be purged by continues centrifuges. The mother liquor separated from

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commercial sugar is again sent to pan for boiling and recryst allization. Three stage of recrystallization are adopted to ensure maximum recovery of sugar in crystal form. The final mother liquor to as final molasses is sent out the factory as waste being unsuitable for recovery of sugar under commercial conditions from economical point of view. Final molasses used as a base fro cattle feed in the manufacture of industrial alcohol, in yeast production etc.

WATER BALANCE—

Sources

(1) Water comes from outside such as river, canals, well, dam borewell etc.

(2) Water comes along with sugarcane.

Use—The water utilized in the sugar industry can be classified in to two categories.

(1) External Water (Cold Water)—The external water does not generally come in contact with the sugar does not generally come in contact with the sugar manufacturing process directly. The external water such as cooling water used for condensing and cooling power turbines, mill turbines, mill bearings, crystallizes sulfur burners, air compressors, vaccum pumps, hot liquor pumps etc. and water used for floor washing, vessel washing and domestic use.

(2) Internal Water—The internal water such us the water from the cane itself imbibition water, clarification water, boiling water and purging water which is directly involved in the sugar manufacturing process. Clean cane containing about 70% water, wherefore the water coming from the cane itself is a primary source for sugar manufacturing process. The water from cane itself in the form of condensate is more than sufficient for the internal process of sugar manufacturing such as condensate water used for imbibition, boiler, filter, cake washing, milk of lime preparation movement water at pans, molasses, dilutions, centrifugals, melting etc.

SOURCES OF EFFLUENTS—

The waster water generated from different sub-streams can be classified as follows—

(**1) Mill House—**The effluent consists of water used fro cleaning the mill house floor which is liable to be converted by spills and pleased sugar juice (This clearing up operation will prevent growth of bacteria on the juice-covered floor).Water used for cooling of mills also forms part of the waste water from this source. Basically this water contains organic matter like sucrose, bagacillo, oil and grease from the bearings fitted in to the mills.

(**2) Waste Water from Boiling House—**The waste water from boiling house results from leakages through pumps, pipelines and the washings of various section such as evaporators, juice heaters, clarification, pans crystal is action, and centrifugation etc. The cooling water from various pumps also forms part of water.

(3) Waste Water from Boiler Blow-down— The water used in boiler contains suspended solids dissolved solids like calcium salts, magnesium salts, sodium salts, fatty salts etc. These salts get concentrated after generation stream from the original water volume. These solids have to be expelled time to time to save the boiler being covered up by scales.

(4) Excess Condensate—The excess condensate does not normally contain any pollutant and is used as boiler feed water and the washing operations. Sometimes it gets contaminated with juice due to entertainment of carry over of solids with the vapours being condensed in that case if goes in to the waste water drain. The treatment requirement in this case is almost negligible and can replace fresh water or let out directly as irrigation water after cooling it to ambient temperature.

(5) Condenser cooling water—Condenser cooling water is recirculated again unless it gets contaminated with juice, which is possible due to defective entrainment separators, faulty operation beyond the design rate of evaporation etc. if gets contaminated, the water should go into the drain invisibly. This volume of water is also increased by additional condensing of vapour of trained from the boiling juice the pan.

(6) Soda and Acid Wastes— The heat exchangers and evaporator are cleaned with caustic soda and hydrochloric acid in order to remove the formation of the deposits of scales on the surface of the tubing. In India, most of the sugar factories let this valuable chemical go into drains. The soda and acid wash contribute considerable amounts of organic and inorganic pollutions and may cause shock loads to waste water treatment once in a fortnight or so.

DIGRAMMATIC REPRESENTATION OF VARIOUS PROCESS AND WASTE WATER SOURCES IN A SUGAR FACTORY

Volume of Effluent —

Volume of effluent use from mill to mill depending on the crushing capacity of mill and reliability and management of water conductor of plant machinery etc.

Waste Water Generation for 2500 TCD Plant

Sr.No.	Source	M^3/day
1	Mill bearing (External cooling)	100
2	Hot liquid gland cooling	150
3	Daily cleaning and washing	100
4	Laboratory use	006
5	Domestic	090
6	Spray pond overflow	102
7	Excess condensate	200
8	Boiler Blow-down	075
9	Periodical Cleaning	075
10	Leakages & Stream Trap	100
	Total	998=1000

Characteristics of Effluents

The characteristics of individual and combined effluents very from mill to mill and from time to time. All the individual effluents excluding spray pond overflow are acidic and coloured posters disagreeable older, high BOD and suspended solid. The oil and grease content is also high. The characteristics of effluents of a typical sugar mill are given in the following table.

TABLE

Physico-chemical characteristics of sugar mill effluent

Sr.No.	Parameter	Range
1	pH	6.5-8.8
2	Dissloved Oxygen	0-2.0
3	BOD	300-2, 200
4	COD	1360-2, 000
5	Chlorides	18-40
6	Total Solids	870-1950
7	Total dissolved Solids	400-1650
8	Suspended Solids	220-790
9	Sulphate	40-70
10	Oil and Grease	60-100

Al l values except pH are expressed in mg/lit.

Effects of Effluents—Organic pollutions presents in the effluent are sugar and other carbohydrates. The immediate oxygen demand by these effluents causes rapid depletion of dissolved oxygen of receiving streams resulting in anaerobic conditions. These results in the release of foul odour and in the production of hydrogen sulphide which precipitates iron as black sulfide leading to unsightly appearance. All these effects make the water totally unfit for fish and other aquatic life. Also the dissolved and suspended solids deteriorate slowly resulting in obnoxious odor. Further, suspended impurities block the drainage and detaches. The excess oil and grease content is a nuisance which prevent aeration. The effluent which are coming from sugar industry if it is directly used for agricultural practices i.e. irrigation purpose then it will affect the soil fertility as well as it affect the plant growth and seed germination. Ramkrishan (2001), reported that the sugar mill effluent reduced the rate of germination of seed on the paddy crop. Sugar mill effluents also affect the soil fauna. The bacterial and fungi which maintain the soil fertility it will be affected by the highly toxic chemicals releases from sugar mill effluent. It has been reported by Ramkrishan et.al., (2001), studied the effect of sugar mill on VAM fungi. Senthil et.al., (2001), studied on physico-chemical characteristics of sugar mill effluent having highly toxic chemicals and heavy metals are affecting aquatic flora and fauna. Economically important fishes having nutritive value which are under threat due to discharge of sugar industry effluent into fresh water ecosystem. This is due to depletion of dissolved oxygen (Avasan, 2001).

SUGGESTIONS

** Industries should be installed in low laying areas away from the public locality. * Industrialist should use such raw materials which will give maximum good products and less toxic waste in fewer quantities. * Industrialist should check their instruments / equipment to avoid leakage. * Workers should make proper use of raw materials and should handle carefully to avoid unnecessary waster. * Each company should promote among its employees and individual since of environmental responsibilities making them at least aware about environmental pollution.* Each industry should follow environmental policies, regulations and environmental protection acts to conserve the environment. * Each industry should have ETP plant to treat the effluents, which can be further used for the agricultural purpose. * Solid waste should be deposited of making its use for the purpose of land fill or on waste land.*

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