Sezela Mill Process Description.

Sezela Mill is a cane sugar factory that processes approximately 1.95 million tons of sugar cane per year. This is typically a 38 week crushing season (between April and December) at a time efficiency of 85% - which allows for breakdowns, scheduled maintenance stops, and weather interrupted cane supply. The factory is shut down for the rest of the Off-Crop for maintenance.

Bagasse is a fibrous residue produced in the sugar manufacturing process and used as one of the fuel sources in the steam and power generation plant. In addition, bagasse is used as an input material to the Downstream Products plant where Furfural is made. The fibrous residue material is returned to the steam and power generation plant as fuel for the boilers.

Bagasse is considered a renewable energy resource, and is used in the sugar industry to off-set the burning of coal in the production of steam and electricity.

The sugar production processes is discussed below:

Cane Handling

The cane receiving and handling process is where the sugar cane is delivered to the cane yard via hauliers. The cane is then off-loaded at the cane-yard where it either directly fed into the manufacturing process or stored in the yard awaiting the manufacturing process. Sezela is designed to crush cane at a maximum rate of 450 tons per hour; however the Mill has only achieved an average rate of 380 tons cane per hour in recent years due to a dwindling cane supply.

Emission: Cane dust.

Cane Sugar Juice Extraction

Cane entering the manufacturing process is first prepared in a set of Cane Knives and a Shredder. The prepared cane is passed through a Diffuser where the juice, containing sucrose, is extracted. The exiting moist cane is then dewatered through a set of mills. Bagasse is a fibrous residue resulting after the juice is extracted from the sugar cane and is used as a fuel source in the boilers as well as a raw material in the Downstream Products process. The extracted juice is processed to produce sugar and molasses.

Emission: None

Raw Sugar Process

Milk of lime is added to the juice from the extraction process for pH control. The juice is then heated and flocculants added to aid in the clarification process where mud and other suspended solids are removed from the juice. This clear juice is further processed via an evaporation process where the concentration of the clear juice is increased to produce syrup. The evaporation process takes place in heat exchangers and the heating medium is steam or vapour.

The syrup is then processed by introducing tiny grains of sugar and further boiling and evaporation until a liquor containing the correct sugar crystal grain size is achieved. The sugar crystal is then separated from the liquor via a centrifugation process. The resultant product is Molasses and Raw Sugar. Sezela produces approximately 85,000 tons of molasses per season and approximately 225,000 tons of Raw Sugar per season. Molasses is transported off site for use as a raw material by others. The Raw Sugar is transported in bulk to the Sugar Terminal in Durban.

Emission: Sugar dust

Downstream Products Process

A portion of the bagasse leaving the cane sugar juice extraction process is used in the 'Downstream products process'. The remaining portion is sent for use as fuel in steam and power generation. The bagasse entering the Downstream process is separated into coarse and fine fractions. The coarse fraction is processed further and the fine fraction is sent for use as fuel in steam and power generation.

The coarse fraction of the bagasse is fed into one of several reactors where steam is introduced. This process extracts Furfural from the bagasse. The 'cooked' bagasse is discharged as bagasse residue which is returned for use as fuel in steam and power generation.

Emission: Cane dust

Steam and Power Generation

Bagasse, bagasse residue and coal are used as fuel sources in the steam generation plant which consists of four boilers, two of which are Listed Activities boilers - Boiler 1 and Boiler 4. Boiler 1 is fueled with bagasse only while other boilers use mix fuel. Approximately 640,000 tons of bagasse and 35 000 tons of coal are burnt per 38 week season (3-year average). Steam is produced at a rate of approximately 330 tons per hour combined for all four boilers. The high pressure steam range (31bar) is used in the Power Generation plant as an energy source for the steam turbine driven electricity generators (turbo-alternators or TA's), as well as for the steam driven prime movers in the cane sugar juice extraction process. The electricity is generated at a rate of approximately 12MW, to power the

electric driven equipment in the processes making the factory self-sufficient in terms of electrical demand.

The steam exhausted from the TA's is used as a heating medium in the raw sugar processes. The condensate resulting from the heating processes is returned to the boilers to be converted to steam.

Emission: Particulates, SO2, NOx.

Effluent Treatment Plant

The Sezela Waste Water Recovery Plant consists of two Waste Water Treatment Plants viz. the Effluent Treatment Plant (ET P) which is a Conventional Activated Sludge Plant (CAS) and a Membrane Bio-Reactor (MBR) which is a modern Activated Sludge Plant capable of treating higher COD (Chemical Oxygen Demand) effluents.

The influent into the two plants are separate. The ETP accepts effluent that emanates from site plant wash downs, sewage and storm water. The MBR is dedicated to the treatment of the Furfural Plant Effluent from the Azeotrope column via Effluent Cooling Towers and the DAF Plant.

The ETP receives waste water from six different sources around the Sezela Complex. These are the:

- North Outfall which is situated on the North side of the Sugar Mill's molasses tank, the
- Stores Sump which is located near the Main Stores on the North side of the East Diffuser,
- the Boilers Sump along the main factory road near Boiler 4,
- New East Drain situated at the bottom of an embankment below the Downstream Boilershop.
  - The East drain is a collection point for the Furfural plant:
    - washing,
    - filtration plant washing,
    - cooling tower,
    - the Boilers emergency dam and
    - storm water from all these areas.
- the 50 ton tank which collects effluent streams from the:
  - FA Plant and
  - Diketones Plant and finally
- sewage from the village. The mill has been in agreement since 1999 with the local municipality to assist with the treatment of sewage from the village as they were unable to do so. An agreement with the mill and the municipality has since been standing.

All four sumps have sample points and flowmeters and recorders. The Plant Operators take meter readings and collect samples from each of these, first thing every morning. The samples are taken to the Downstream Laboratory for analysis.

Two extra samples and readings are taken in the plant itself, these are the Final Effluent (Treated Water) and the Incoming Combined Total Volumes and quality. These are monitored for Ph, TDS and COD.

Near the inflows is situated a Bar Raked Screen which removes the bulk of the inflows solid waste such as bagasse and rags which is then deposited into drums. Nutrients such as phosphoric acid and urea are added before the rake into the incoming effluent after an incident of contamination to assist with normalising the plant.

Immediately after the rake, situated above the channel is a flow transmitter which monitors the effluent inflow. After the flow transmitter there is a paddle wheel auto sampler whose catch pot sends ongoing samples to the inflow composite sample.

Situated further along the channel are two grit settling chambers which serve to remove any remaining solids, such as ash and sand, in the effluent stream. After this the channel runs directly to the pre-treatment Aerated tank with the available diversion route to the Activated Sludge Reactor.

The Aerated tank is used to store the mixed liquor viz incoming waste water, dosing chemicals and recycle activated sludge. The Aerators facilitate pretreatment of the waste water by agitating the mixture. Two large floating surface aerators are also installed in the pre-treatment tank. The agitation produces a spray of droplets that absorb oxygen from the air before falling back into the aerated tank.

The activated sludge reactor is a biological reactor that uses micro-organisms such as bacteria to consume biodegradable organ contaminants from waste water. The waste water is generally contaminated with bagasse, sugars and traces of organic chemicals that are manufactured at the Sezela complex. The activated sludge reactor has 3 vertical surface aerators similar to the ones in the aerated pre-treatment tank. The solids content of this tank is maintained at a concentration of between 6 000 and 10 000 ppm in order to obtain a high purification efficiency. The activated sludge mixed liquor suspended solids (MLSS) from the aerator pre-treatment tank is allowed to flow into the activated sludge tank by closing valve P4 and opening valve P3. The flow is by gravity therefore the flow rate will depend on the level of the aerated pre-treatment tank. The level of the aerated sludge reactor will also dictate the flow rate of activated sludge mixed liquor (MLSS) to the clarifiers that is situated just downstream of it as it flows gravitational over an adjustable weir.

The clarifier allows the activated sludge to settle out of the mixed liquor. Clear treated effluent water (final effluent) is recovered from the top of the clarifier through a series of V-Notches. The final effluent is either discharged to the Maturation River or directly to the final effluent pump station which will transfer it to one or more of its destinations i.e. the Boilers for use in the scrubbers or to sea.

The sludge from the underflow is recycled back to the head of the works by one or both of the two sludge recycle pumps. During the crushing season the excess sludge is wasted via the sludge recycle pumps (5%) to the volute where it is filtered in the de-waterer with the recovered water draining into maturation and filter cake conveyed by the screw pump into the trailer for dumping.

During the season the final effluent is pumped to the Sugar Mill Boilers to be used as scrubber water for the boiler stacks. During off-crop the final effluent is pumped to the sea. When the final effluent is found to contain a solids content that is greater than 25 ppm and or a Chemical Oxygen Demand (COD) that is greater than 100 ppm, it is diverted to the Maturation River to allow further biological treatment and the excess solids to settle.

Membrane Bio-Reactor (MBR)

The MBR is a biological Activated Sludge Treatment Plant built as a Pilot Plant to treat Acid Water from the Furfural Plant Effluent which is currently being discharged to the sea under the licence issued from DEA — Oceans and Coast. The waste water has a COD of ± 18 000 ppm which is too high for treatment in the Conventional Activated Sludge Plant. As mentioned previously the MBR treats effluent from the Azeotrope column via the cooling tower and DAF (Dissolved Air Flotation) Plant. The major liquid effluent stream form the furfural azeotrope distillation consists of mainly water with 1.5% acetic acid.

This reactor is equipped with two large Fine Bubble Air Blowers (FBDA 1 & 2) and a smaller Coarse Bubble Membrane Air Blower. The FBDA blowers pump air into the bottom of the reactor via a network of plastic pipes. The treated water (Permeate — PMT) is separated from the Activated Sludge by a series of semipermeable membranes mounted on a platform that is situated on the North side of the tank. The arrangement of the Membrane is that of a Double-Deck and each deck has twelve membrane banks, each bank comprising 200 flat sheet Kubota Membranes. The screens in the membranes catch the solids. The treated effluent is then pumped to sea during off-crop and in season joins final effluent to the mill. When the membranes become too fouled up a chemical clean is required.