

# WASTE WATER MANAGEMENT AT SEZELA

By S. S. MUNSAMY, A. M. NADASEN and M. PONNUSAMY

CG Smith Sugar Ltd, Sezela

## Abstract

There are five waste water streams which comprise domestic sewage, sugar mill effluent, boiler scrubber water, factory stormwater and chemical plant effluent at Sezela. The effluent streams are treated in two treatment systems which comprise an activated sludge waste water treatment plant and a smuts pond system. The treated effluent from the activated sludge treatment plant has started to approach the level of 75 mg/l COD in the crushing season due to increased hydraulic loading. However by recycling the treated effluent into the boiler gas scrubbing system the effluent is further treated in the smuts ponds. Treated waste water leaves the Sezela complex at one point only and the water quality at the point of discharge into a natural water source has a Chemical Oxygen Demand (COD) and Oxygen Absorbed (OA) content of around 15 mg/l and 4 mg/l respectively.

## Introduction

The diversion of part of the factory storm water and domestic sewage together with the expansion of the adjoining chemical plant has resulted in capacity problems at the effluent treatment plant. The hydraulic load on the treatment

plant has reached double the design load during the crushing season and for three out of nine months the Chemical Oxygen Demand (COD) level of treated water was above specification in the 1991 season. This paper describes how, by using the smuts pond as a polishing step, standards for discharge have been met and capital expenditure on expansion of the treatment plant avoided. The waste water management system is shown in Figure 1.

## Discussion

### Storm water

There are three storm water discharge points around the factory, two leading onto the beach and one into the estuary.

The major source of pollution is the cane yard where cane transport vehicles drive over spilled cane. The rain washes the pollutants into the storm water system and black patches of dirt on the beach used to be a common sight at Sezela. In addition factory washing found its way into the drain system and there used to be a continuous discharge of smelly juice and oil bearing liquid on to the beach and the estuary.

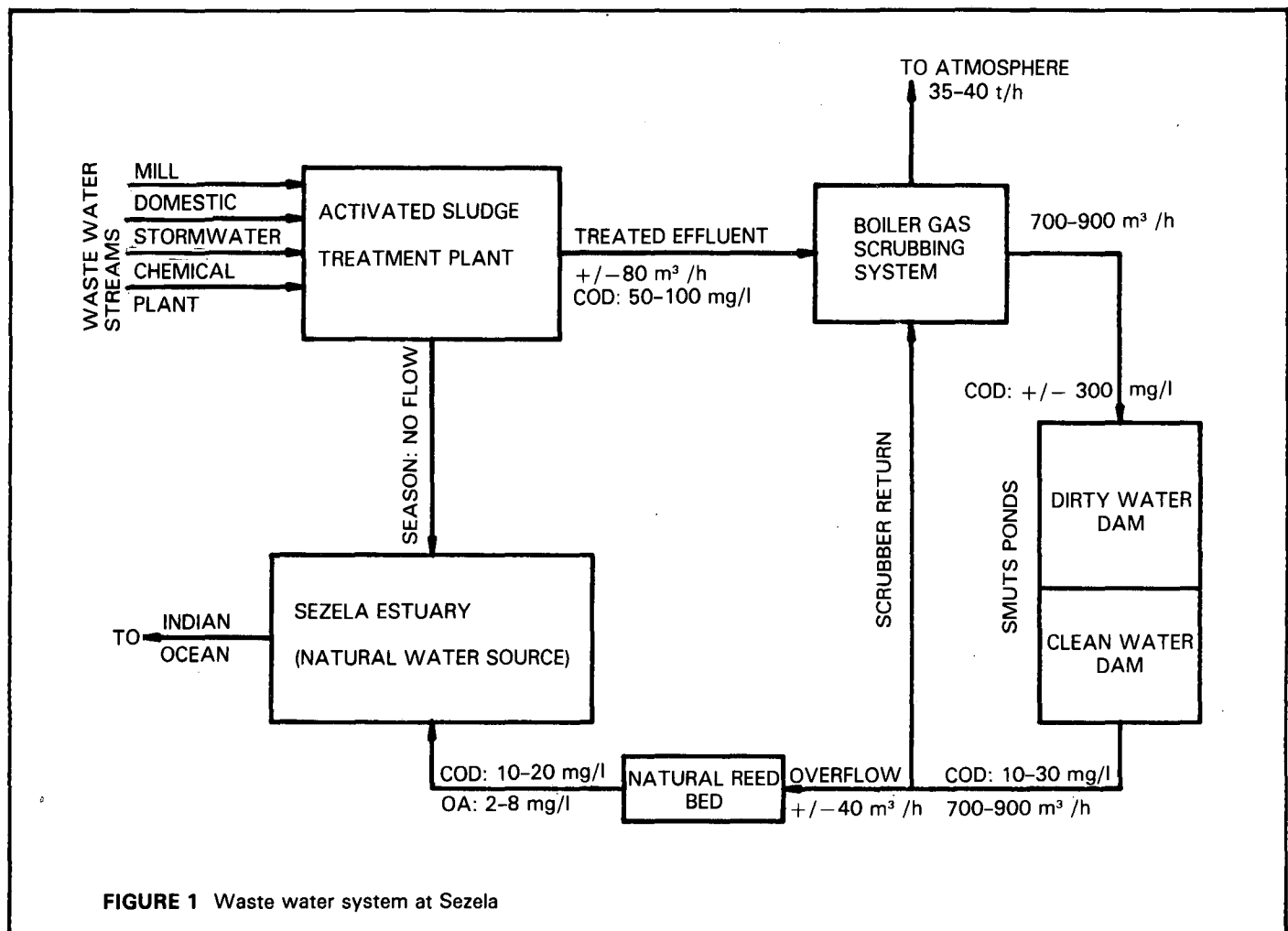


FIGURE 1 Waste water system at Sezela

These discharge streams although small in volumetric flow during dry weather were aesthetically unacceptable and the mill had to formulate a method to stop the pollutants from getting onto the beach and into the estuary.

Three catchment pits were installed on the three discharge points. The intention of the pits was to trap the small flows during dry weather and to trap the first run off during rainy weather. After the first runoff is trapped any further inflow is diverted onto the beach or the estuary. The trapped liquid which has the highest concentration of pollutants is then pumped into the effluent treatment plant. During light rain the inflow into the pit is continuously pumped into the treatment plant. During dry weather the pit drain valves are set in such a manner that all inflow, mainly floor and yard washing, is pumped into the treatment works.

The run off from the cane yard was sampled during heavy rainfall in September 1987 and the results are shown in Table 1. The first seasonal rain was recorded on 21 September 1987.

Table 1

Rainfall and storm water COD values

Date	Daily rainfall (mm)	Accumulative rainfall (mm)	Storm water COD (mg/l)
21-9-87	42	42	14 400
22-9-87	6	48	5 100
23-9-87	0	48	-
24-9-87	3	51	1 400
25-9-87	2	53	1 000
26-9-87	64	117	600
27-9-87	56	173	800
28-9-87	138	311	800
29-9-87	52	363	700
30-9-87	6	369	400

During the 1991 season the stormwater that was pumped from one of the pits to the effluent treatment plant was analysed and the results are shown in Table 2.

Table 2

Analysis of liquid from catchment pit to effluent plant

Date	Rainfall (mm)	COD (mg/l)	TDS (mg/l)	pH	Suspended solids (mg/l)
09-10-91	19	16 800	1 450	4,2	1 300
10-10-91	7	3 500	600	4,2	150
12-10-91	30	2 200	550	4,7	850
13-10-91	18	1 800	150	4,8	150
14-10-91	7	2 300	450	6,4	400
20-10-91	30	3 800	600	5,1	350
21-10-91	17	1 000	300	5,2	250
15-11-91	66	2 400	700	6,1	500

### Effluent treatment plant

The waste water treatment plant at Sezela uses the activated sludge process and has been explained in detail by Nadasen (1991).

Due to increased diversion of domestic sewage, chemical plant waste and storm water the hydraulic load on the treatment plant has been nearly double the design load in the crushing season. The quality of treated effluent is shown in Table 3 for the 1991 crushing season. From this table it can be seen that the treated effluent did not meet the requirements of the General Standards of 75 mg/l of COD in three

out of nine months of the crushing season. A preliminary investigation showed that about R600 000 would be required to upgrade the treatment plant to accommodate the increased effluent load. The treatment plant works exceptionally well in the offcrop and treated water is discharged into the estuary.

Table 3

Quality of treated effluent (1991 Season)

Month	COD (mg/l)	OA* (mg/l)	TDS (mg/l)
April	40	11	380
May	68	22	500
June	96	29	510
July	76	21	450
August	67	10	560
September	65	19	600
October	80	31	520
November	50	23	560
December	50	11	550

\* OA = Oxygen absorbed

### Smuts ponds

The fly ash and boiler grate ash handling and disposal at Sezela has been explained in detail by Munsamy (1989). A similar system at Umzimkulu mill was described by Vermeulen and Vawda (1989). In addition to boiler scrubber water the ash system handles all the injection cooling water overflow and the evaporator cleaning and pressure testing water. In the crushing season all the treated effluent is fed as make up into the boiler scrubber system. It is estimated that the boiler scrubbers require about 40 tons of make up per hour. The effluent treatment plant produces about 80 tons per hour of treated effluent which is in excess of the make up requirement. The quality of the water after the boiler scrubbers varies according to the type of fuel burnt in the boiler. Sezela mill uses about 40 000 tons coal per annum because most of the bagasse is diverted to a bagasse based chemical plant attached to the mill. The use of coal tends to depress scrubber water pH. Since the boilers burn coal, bagasse and bagasse residue from the chemical plant in various quantities the quality of water leaving the scrubber varies accordingly. The following quality parameters give an indication of the water quality and flowrates leaving the boiler scrubbers.

Flowrate (m<sup>3</sup>/h): 700-900  
 pH: 5,8-7,2  
 Suspended solids (mg/l): 4 000-6 000  
 COD (mg/l): ± 300  
 Temperature (°C): 60

The Umzimkulu and Sezela experience has shown that the smuts ponds are very efficient COD removers. Unfortunately the COD level of the water entering the Sezela smuts dams has not been monitored regularly but the pH and Total Dissolved Solids (TDS) have been measured daily (Table 4). The smuts ponds and the effluent treatment plant have similar effect on pH and there is a TDS reduction in the smuts ponds.

It is interesting to note that the TDS did not increase during the season but tended to stabilise. The clean water dam overflows intermittently and according to a water balance around the smuts system about 30-40 tons per hour should be discarded from the system. The overflow point is fitted with a measuring weir and an average of about 40 tons per hour is recorded. The excess water from the smut dams is allowed to overflow at the end of the clean water dam

Table 4

Average pH and TDS results of the smuts ponds and the effluent treatment plant for the 1991 season

Month	Effluent treatment plant		Smuts ponds			
	pH (in)	pH (out)	pH (in)	pH (out)	TDS (in)	TDS (out)
April	7,1	7,9	7,2	7,7	1 684	1 339
May	6,9	7,7	7,0	7,7	1 496	1 285
June	6,2	7,3	6,7	7,6	1 474	1 292
July	5,7	7,1	6,7	7,4	1 392	1 318
August	6,5	7,4	6,7	7,5	1 552	1 446
September	6,4	7,5	6,3	7,4	1 596	1 451
October	6,3	7,4	6,1	7,2	1 314	1 177
November	6,6	7,5	6,1	7,5	1 270	1 158
December	6,6	7,2	5,9	7,5	1 300	1 207
Average	6,5	7,4	6,5	7,5	1 453	1 297

and is referred to as final effluent. The overflow is monitored carefully and the highest COD recorded was 40 mg/l. Since the clean water dam does not overflow all the time the impurities in the water concentrate and the level of impurities varies. The overflow point is about a kilometre from the estuary and the water travels through thick vegetation, mainly reeds, before it enters the estuary. There is a further COD reduction while the water travels through the vegetation (Table 5). The water entering the river was of crystal clear quality but the high TDS level is of concern. The SABS specification 241-1984 allows up to 2 000 mg/l of TDS for human consumption purposes. It is not necessarily the TDS level but the concentration of specific ions that is detrimental to human health or the environment. A limited number of samples was analysed and the following ions were detected.

SO <sub>3</sub> <sup>=</sup> :	4-6	mg/l
PO <sub>4</sub> :	9-18	mg/l
Mg <sup>++</sup> :	50-80	mg/l
Ca <sup>++</sup> :	130-170	mg/l
K <sup>+</sup> :	50-1 200	mg/l
N:	<0,1	mg/l

If the treated effluent was allowed to overflow into the estuary then about 80 tons per hour of water at about 530 mg/l of TDS would be discharged in the crushing season between May and December. This is equivalent to a TDS load of about 42,5 kg/h. The clean water dam overflows at a rate of about 30-40 tons per hour at a TDS level of about 1 300 mg/l. At an average rate of 35 tons per hour the TDS load is 45,5 kg/h. However the TDS level of the overflow at the point of entry into the estuary is lower than 1 300 mg/l.

Therefore the TDS loading on the estuary source is not increased by using the smuts ponds as a polishing step.

#### Operation of the smuts ponds

The main objective of the smuts ponds is to remove suspended material from the scrubber water (dirty water) and return clean water to the scrubber. The removal of the suspended material is accomplished by sedimentation and filtration through the ash bed. An important operational requirement of the smuts ponds is that no foul smelling odours are generated. At Sezela odour generation can be a problem if the dirty water dam has stagnant pockets of water that do not drain through the ash bed. If the smuts ponds are to be used for effluent treatment then it is imperative that the flow into the dam is such that the ash bed is level and drains completely in the offcrop.

Coal firing decreases the scrubber water pH and where coal only is burnt for long periods, for example during end of season boiloff, the pH of the dirty water should be monitored. Low pH causes odouriferous organic acids, formed from sugars, to be volatile whereas non-volatile salts are formed at higher pH values.

From an ash removal point of view the dirty water dam needs to be operated with a high water level to facilitate sedimentation of suspended material. From an effluent COD removal point of view the water level should be as low as possible to minimise anaerobic pockets.

#### Advantages and disadvantages of using the smuts dams as a COD remover

A number of advantages are achieved by returning all the treated effluent to the boiler scrubber system:

- All treated effluent is reused in the factory and the quantity of water from external sources is reduced.
- The effluent treatment plant load can be increased in the season and COD levels of higher than 75 mg/l can be tolerated in the treated effluent. This has an immediate saving of about R600 000 in effluent plant expansion cost.
- A number of combinations of waste water management become available. One could selectively divert waste water streams to the treatment plant or the smuts dams.
- Large fluctuations in hydraulic and COD loads can be accommodated.
- By allowing the COD of treated water to rise above 75 mg/l chemical costs at the effluent plant can be reduced.

Table 5

Water quality at point of overflow of the smuts dams and at point of entry into the estuary

Date	At overflow point					At entry into estuary				
	COD (mg/l)	SS* (mg/l)	pH	OA (mg/l)	TDS (mg/l)	COD (mg/l)	SS (mg/l)	pH	OA (mg/l)	TDS (mg/l)
04-10-91	10	110	7,4	2	1 350	10	80	7,7	1	1 300
11-10-91	15	120	6,6	5	1 400	10	60	7,8	2	1 350
19-10-91	30	130	7,0	8	1 350	20	50	7,6	2	950
01-11-91	20	40	6,9	6	1 200	10	20	7,6	2	1 050
07-11-91	10	10	7,4	4	1 300	10	0	7,8	2	1 200
09-11-91	15	20	7,4	8	1 130	10	10	7,7	4	1 250
23-11-91	10	20	7,6	6	1 000	10	0	7,8	4	1 150
18-12-91	10	10	7,1	5	1 250	10	0	7,2	2	1 150
19-12-91	20	40	7,3	4	1 250	10	0	7,4	2	1 050

\* SS = Suspended solids

- (f) A larger quantity of storm water can be captured and diverted to the treatment plant without fear of overloading the plant.

The disadvantages of the system are listed below:

- (a) Poor operation of the smuts dams can generate unpleasant odours which can be carried down wind for long distances.
- (b) The phosphate content in the final effluent can promote eutrophication of the estuary. Domestic sewage contributes about 35-50% of the phosphate content which is carried over from the effluent treatment plant to the smuts system. Two options are available to decrease the level of phosphate entering the estuary. One is to use final effluent for irrigation of cane fields below the smuts ponds. The phosphate and potassium content of the water make it attractive from a fertilizer point of view. The second option is to lead the overflow away from the estuary and into the sea.
- (c) It is not desirable to use the final effluent directly in the sugar process due to the high TDS level. It can be shown that if the water is used for imbibition it can increase final molasses purity by up to one unit due to the ash content.

### Conclusions

The smuts dams provide Sezela with a unique opportunity to produce final effluent at very low COD levels without any expansion of the effluent plant. By returning all the treated effluent from the activated sludge treatment plant to the boiler scrubber system the final effluent that is discharged into a natural water stream is extremely low at present. The findings at Sezela are similar to those of Vermeulen and Vawda (1989) at Umzimkulu. Odour generation is the greatest concern but Sezela Process staff are convinced that dead pockets of water in the dirty water dam are the cause of the odour generation. As the dam fills up the ash level will even out and dead pockets of water will be eliminated. In the last five seasons that treated effluent has been returned to the scrubber system, odour generation was a problem on one occasion only.

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