SIMPLE APPROACH TO RAW SUGAR DRYING AT ILLOVO

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Abstract

A brief description of the cooler/dryer installation at Illovo is given and its performance results over the last ten years are tabulated. A series of tests at the end of the 1983/84 season were carried out under more controlled conditions to confirm the previous year's performance data.

Introduction

The main objective of this paper is to present a simple, low cost and efficient cooler/dryer system, which has been successfully used on the drying of VHP sugar at Illovo over the last nine years (see Table 1).

In 1975 the drying plant at Illovo was modified as part of the first phase of an expansion programme to increase the crushing capacity from 100 to 150 tons cane per hour.

The crushing rate was further increased to 188 tons per hour in 1982 and is now poised for the 1984/85 season to crush at an average of 200 tons per hour with no additional modifications, except for the replacement of one of the original two units.

The operation of the centrifugal station has not changed basically over the years and is still within the minimum practical limits of 15 cycles per hour per machine.

Description of Plant and Operation

The plant consists of two vertical cooler/dryer units working in parallel and fed at the top by a dual screw conveyor system as illustrated in Figures 1 and 2.

The unit is made up of a cyclinder shell (10 m high × 1,8 m ø) and divided into four equal sections by inverted conical baffles. In the centre is a 100 mm diameter vertical rotating shaft (64 rpm) onto which are attached four cones spaced between the fixed baffles.

The sugar is fed at the top of the cooler/dryer and cascades downwards, while the rotating baffles spread it outwards. The fixed cones prevent the sugar from falling straight down and thereby increase the contact time between the sugar and air. The air, which is at ambient conditions, flows counter current to the cascading sugar. Its flow rate is controlled by a damper arrangement in the ducting of the exhaust fan inlet. The quantity of air passing through the cooler/dryer is important for its efficiency, but an excess causes high entrainment.

Sugar dust is removed from the exhaust air by means of a wet cyclone. Contaminated condensate is used for the make-up water and is recycled over a four hour period before being drained to the remelter.

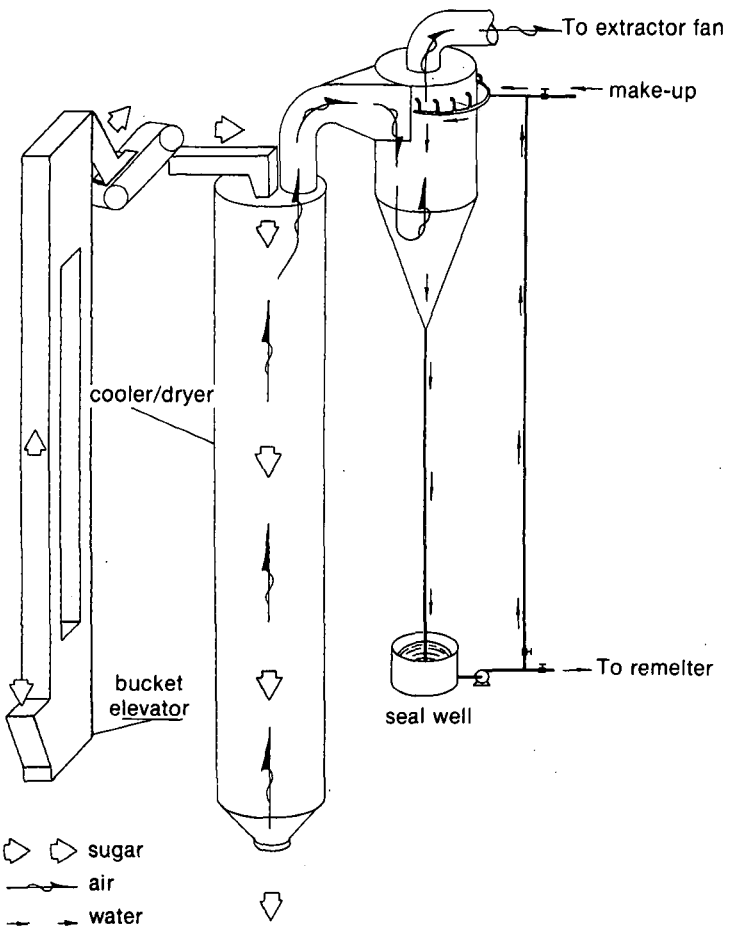

FIGURE 1 Cooler/Dryer Plant

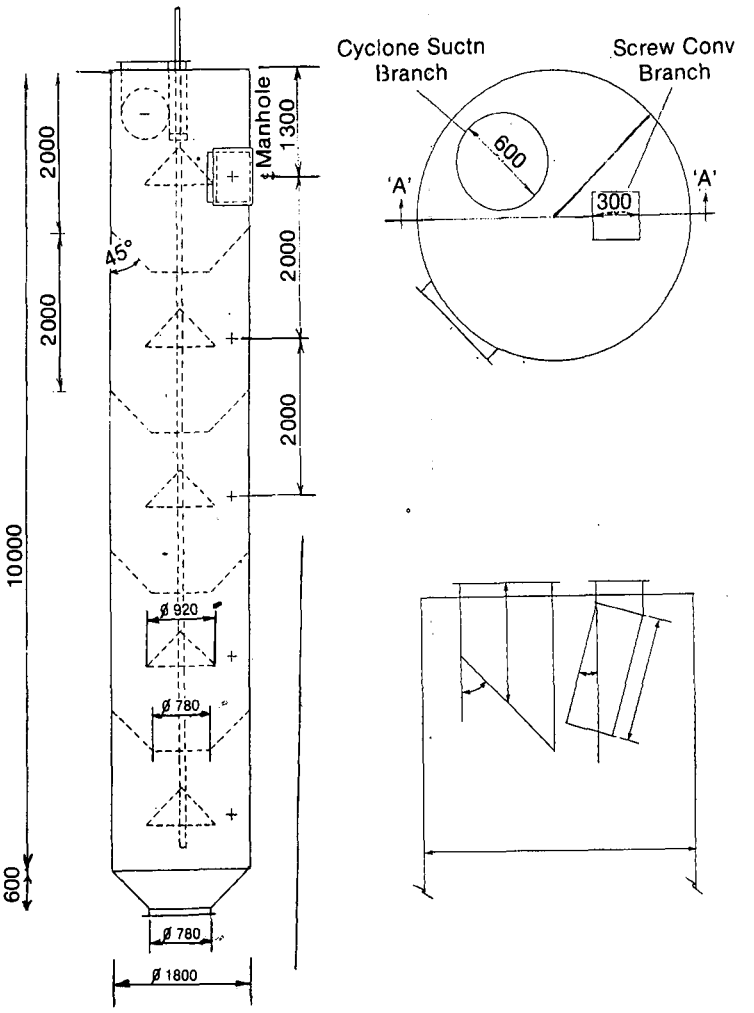

FIGURE 2 Cooler/Dryer design

The present cost of one mild steel cooler/dryer unit, excluding the dust collector system and fan is about R23 000 which is approximately 20 to 30% of the cost of other commercial units of identical capacity.

Results and Discussion

The results for the period 1974 to 1983 and the performance of the plant during tests conducted towards the end of the 1983/84 crushing season are presented in Tables 1 and 2.

Historical data

The general performance of the cooler/dryer during the past ten years is shown in Table 1. The pol and moisture results are the official figures as supplied by the S.A. Sugar Terminal and the Tongaat-Hulett Refinery.

TABLE 1

Comparative data for production and analysis of VHP sugar from 1974 to 1983

Year	Tons Sugar per hour	Tons Sugar for season	Analysis		Penalties Rand
			Pol	% Moist	
1974	11,5	65 840	99,41	0,091	8
1975	13,6	63 708	99,42	0,098	3
1976	15,6	71 110	99,44	0,097	4
1977	17,6	91 440	99,37	0,112	104
1978	17,4	82 217	99,42	0,115	122
1979*	18,2	95 239	99,34	0,122	190
1980*	17,7	68 099	99,50	0,120	986
1981	17,2	82 267	99,42	0,098	628
1982	21,7	108 631	99,36	0,096	Nil
1983	20,2	91 172	99,37	0,185	Nil

* Factory trial using a continuous centrifugal for centrifuging A-massecuite.

Over the years the production rate of VHP sugar almost doubled and yet the overall moisture level remained within specified limits; except for 1983 when the high moisture was due to a combination of small crystal size and one unit being partially out of action for most of the season pending replacement. Prior to 1983 the total penalty paid over the past nine years for sugar moisture outside specifications amounted to R2 045 for an equivalent sugar production of 72 8551 tons.

Experimental results in 1983

The average results of the tests carried out in November 1983 over a period of forty-four hours at a sugar throughput of ±22 metric tons per hour are shown in Table 2. In spite of the relatively high ambient temperature and relative humidity, the sugar moisture was reduced from 0,33 to 0,10 which is within specifications and confirms the overall results of the 1982 season as shown in Table 1.

TABLE 2

Summary of experimental results November 1983

	Air				Sugar			
	Temperatures °C		% Relative Humidity	Velocity of Air inside cooler/dryer (M/Sec)	Temperatures °C		% Moisture	
	Dry Bulb	Wet Bulb			Inlet	Outlet	Inlet	Outlet
Average	27,15	24,35	78	0,6	55,7	32,9	0,327	0,099

Residence time distribution

The residence time of the sugar in the cooler/dryer was established by means of a series of pulse tracer tests. The method employed was similar to that used by Fitzgerald,[1] except that blue food dye was used to coat the VHP sugar.

For the test, 200 g of coated sugar was introduced into the inlet of the cooler/dryer and the response was determined by measuring the optical density at 633 nm on the outlet samples.

The results of the tests are shown in the reduced concentration profile of Figure 3.[2] The mean residence time for this particular unit was found to be relatively short at 13,6 seconds.

Operating Conditions

It must be mentioned that in spite of its cost effectiveness and simplicity of operation, the Illovo cooler/dryer plant is nevertheless somewhat limited in the quality and type of sugar it can handle. The following requirements have been found necessary for the efficient operation of the unit:

- A steady and well distributed feed from the centrifugals.
- A sugar of at least the following specification for pol and grain size: 99,20 and 0,60 respectively.
- A minimum sugar temperature of 55°C at the inlet of the unit.
- A maximum moisture of 0,60% out of the centrifugals.
- An adequate supply of air at an ambient temperature not higher than 32°C.

Conclusion

Despite certain reservations about the versatility of the cooler/dryer system, it has nevertheless met the operating requirements of Illovo over the years at a very low capital and maintenance cost.

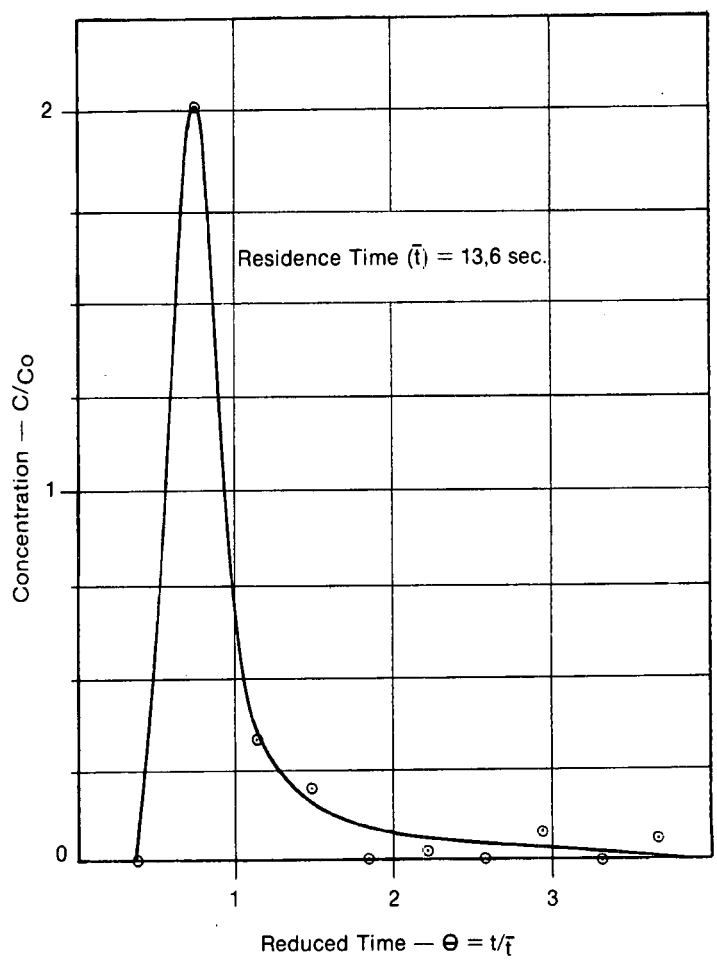

FIGURE 3 Residence time distribution curve

Acknowledgements

The assistance and technical advice received from Illovo management and staff is gratefully acknowledged.

REFERENCES

1. Fitzgerald J. R. (1980) The performance of a fluidised bed refined sugar dryer *Proc S Afr Sug Technol Ass* 54: 52–55.
2. Levenspiel O. (1962) *Chemical Reaction Engineering*, Wiley and Sons, New York.

APPENDIX 1

Cooler/Dryer Specifications:	
Manufacturer	Illovo Mill
Cylinder	10 m × 1,8 m diam.
Thickness	6 mm
Drive motor	3,75 kW 1430 rpm
Pulley ratio	100 : 150
Gearbox	15 : 1
Shaft speed	± 64 rpm
Cyclone	
Top	920 mm diam.
Taper	110 mm diam.
I.D. Fan	Type: Howden SAFANCO D_2
Motor	7,5 kW 1430 rpm
I.D. Pipe	Diam. 350 mm
Water	Pressure 400 kPa