DEVELOPMENTS IN SOUTH AFRICAN SUGAR FACTORY PLANT INSTALLATIONS 1969-1973

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Abstract

Tables of some installed process equipment in South African factories are given together with comment on developments in plant design during the last four seasons.

Introduction

In 1969 an inventory of installed plant was published[1] and this paper brings this data up to date while drawing attention to developments which have taken place since then. Data is presented using the SI system of units. Thirteen tables are given listing the major items of plant installed in the South African sugar factories at present.

No refinery plant is listed but there are several "back-end" refineries operating and as a result boiler power plant and boiling house capacity must be treated with caution when considering these factories. They are shown below together with the percentage white sugar made (1972/73):

ML 95
PG 70
EN 34
GH 86
SZ 44

Irrigation loads make further demands on boiler and power plant and some factories are supplying small amounts of power to by-product plants. For this reason an "average" power or boiler plant installation is difficult to establish. ML, PG, GD, TS and ME carry large irrigation loads.

The diffuser factories are ML, PG (1973/74) UF (one third of total factory throughput to date) EM, EN and UC. Diffusion plants require, in general, less clarification equipment as the bagasse mat acts as a reasonable filter bed in removing much of the mud and fines associated with dirty cane.

In order to provide the information concerning a milling tandem in a compact way, identical units (and drives) are placed in separate columns not necessarily in their order through the tandem. The mill or drive is identified in each case by the numbers from 1 to 7, immediately above the plant description. The drive details are identified only by the above-mentioned numbers and *not* by the mill (or diffuser) which happens to be printed immediately above it.

Plant capacity has been associated with tons cane per hour in the tables (tons fibre for preparation equipment) and is given solely as an order of magnitude. To relate the throughput of a particular plant item to clear juice, massecuite or purities etc., relevant data for each factory is published by SASTA in an Annual Review of each season.

Installed plant can be confusing, when related to throughput, but data obtained of actual capacity used, e.g. steam flow, power generation etc., proved to be insufficient to provide comprehensive tables and was for that reason not included.

Cane preparation

Recently considerable attention has been focused on good cane preparation as a means of improving milling performance. Shredder hammers and grid configurations have been redesigned, more horsepower installed, reversed rotation and swing knives are being used and technical interest is still great in this field. With the use of the overhead anvil plate, what is virtually an inverted shredder has been created. Tongaat have designed a new shredder rotor and housing with resulting improvement in Preparation Index figures and hence milling performance.

That this work has paid dividends needs no emphasising when Amatikulu in 1971, after modifications to its shredder (and feeder rollers) increased its throughput from 250 to 280 tch and reduced its LAJ from 29 to 25 together with a reduction of 1,36 points in final bagasse moisture. This was achieved despite a reduction of 5% in imbibition % fibre.

The installation of rubber belt conveyors for prepared cane to replace traditional slat conveyors at a much lower capital and eventual maintenance cost is finding favour. After Jaagbaan's first installation in 1966 several installations have been made recently; at Tongaat, Amatikulu and Pongola, after the shredder and at MV, UF and PG from the cane knives to the shredder. These conveyors do not include the conventional short centre flat belts found under magnetic tramp iron separators. Gledhow and Tongaat use 2,1 m belts for cane transport in the caneyard.

Direct cane sampling

Soon direct cane sampling installations (including laboratories) will have been installed at all factories by the Central Board. Shredded cane is sampled from automatically-timed full width hatches which allow bulk samples to fall into suitable preparatory equipment for subsampling and analysis. The rejected portion of the cane sample is returned to the carrier. A major significance of these installations is that cane sampling no longer restricts extraction technology to having a crushing unit to provide first expressed juice samples. Cane diffusion is now possible (that is, in contrast to bagasse diffusion) and Huletts Sugar Corporation has wasted no time in making use of this fact with the proposed Amatikulu cane diffuser for 1974.

Mills

Gledhow has converted its chain driven feeder rollers to gear drives after extensive alterations to

CANE PREPARATION

K = Cane knives
A = Overhead anvil plate
E = Electric motor
300kW = 402 HP.
S = Shredder
R = Reverse Rotation
+ = Coupled motors
T = Steam turbine
LK = Leveller knives

Factory	Carrier Width mm	Set/ Shredder	Power kW	Drive	Speed rpm	Blades/ Hammers No.	Swept Diam. mm	Clearance mm	Hammer Mass kg	Total Power kW	Power/ Fibre kW/tfh	tfh
ML	2 134	1K	447+447	E	600	44	1 854			1 788	53,9	33,2
		2KRA	447+447	E	600	88	1 854					
PG	2 134	1KRA	895	T	750	88	1 829	10		1 790		19,6
		S	895	T	1 200	99	1 320	5	10			
UF1	2 134	LK	149	E	—	12	1 524	—		1 298	60,4	21,5
		1K	336	E	495	50	1 905	254				
		2KRA	328	E	738	56	1 600	13				
		S	485	T	1 000	400	1 346		4			
UF2	1 676	1K	186	E	735	64	1 549	254		633	56,0	11,3
		2KRA	186	E	735	48	1 623	25				
		S	261	E	960	300	1 270		2			
EM	2 134	1KR	750	T	550	44	1 829	203		1 500	45,7	32,8
		2KR	750	T	650	66	2 134	25				
FX1	1 676	LK	150	E	720	30	1 574	400		1 325	80,0	16,6
		1K	335	E	735	36	1 524	62				
		2K	245	E	735	64	1 400	30				
		S	595	E	982	88	1 270		16			
FX2	1 524	1KR	223	E	590	30	1 674	19		854	70,6	12,1
		2K	186	E	736	56	1 624	62				
		S	445	E	981	68	1 270		16			
EN	1 219	1K	89	E	550	24	1 066	431		311	45,7	6,8
		2K	111	E	600	32	1 371	75				
		S	111	E	975	64	762		6,5			
AK	2 134	LK	186	E	585	22	1 524	1 067		3 750	85,2	44,0
		1KRA	750+750	T	600	88	2 413	203/38A				
		*2KA	750	T	600	48	2 134	12				
		S	1 864	E	980	164	1 728	8–18	22			
DK	1 676	1K	185	E	750	28	1 429	250		668	63,6	10,5
		2K	260	E	580	30	1 525	20				
		S	223	E	982	312	1 270		2			
GD	1 219	1K	149	E	480	22	1 879	50		349	56,3	6,2
		2K	89	E	480	44	1 778	13				
		S	111	E	1 000	288	1 270		2			
DL	2 134	1K	410	T	600	36	1 574	37		1 610	52,8	30,5
		2K	450	E	960	36	1 574	25				
		S	750	T	1 000	200	1 219		16			
GH	2 134	LK	185	E	292	32	1 978	1 370		1 975	52,9	37,3
		1K	335+335	E	490	108	1 978	38				
		2KRA	450	E	490	54	1 828	75/6A				
		S	670	T	1 000	267	1 219	6	4			
MV	1 828	1K	149	E	600	36	1 524	250		558	47,3	11,8
		2K	186	E	600	88	1 524	20				
		S	223	E	983	328	1 270		2			
JB	2 134	1K	447	E	593	40	1 524	216		1 415	47,8	29,6
		2K	447	E	593	64	1 524	13				
		S	521	E	960	408	1 219	5	4			
UC	1 828	1KR	201	E	600	32	1 630	25		599	74,9	8,0
		2K	398	E	600	64	1 480	25				
TS1	2 134	LKR	135+135	E	540	36	1 371	500		1 796	61,7	29,1
		1K	335	E	495	48	1 524	100				
		2K	300	E	720	66	1 524	25				
		S	895	T	1 200	188	1 524		17			
TS2	2 134	1KR	260	E	600	66	1 524	250		1 190	79,9	14,9
		2K	260	E	600	78	1 524	25				
		S	335+335	E	960	132	1 290		17			
ME	2 134	LK	56	E	490	22	1 321	1 041		1 906	68,6	27,8
		1K	280	E	590	42	1 524	406				
		2K	450	E	960	42	1 879	25				
		S	1 120	E	960	200	1 270		16			
IL	1 828	1K	75	E	613	32	1 524			893	58,4	15,3
		2K	223	E	590	32	1 524					
		3K	260	E	590	64	1 524					
		S	335	E	960	240	—		7			
RN	1 625	1K	111+92	E	580	38	1 447	150		612	52,8	11,6
		2K	186	E	580	60	1 447	13				
		S	223	E	970	320	1 219		2			
SZ	2 134	1K	447+164	E	590	40	1 524	230		2 908		36,8
		2K	447	E	590	80	1 448	12				
		S	1 850	T	1 500	216	1 524	10	17			
UK	1 828	1K	550	T	580	56	1 270	—		1 550	69,0	22,5
		2K	223+223	E	580	64	1 346	—				
		S	559	T	1 000	352	1 219		2/3			

*Anvil plate under knives.

MILLING TANDEMS AND DRIVES

KEY TO TABLE ARRANGEMENT

ML 1,2	(Dewatering)	Mill unit no.
2 134 × 1 067		Roll length × diameter
38	40°	Groove pitch × angle
5R	1 067	Feeder roll type × diameter
1,2		Mill unit no.
T	559	Type of drive, power kW
31	4 500	steam press. bar × rpm or / voltage × rpm

ABBREVIATIONS AND FEEDER ROLL DESCRIPTION

LFR	Fabricated feeder roller
HFR	Cast feeder roller
4R	Pinion driven feeder roller
5R	Pressure feeder mill
6R	AK No. 1 mill has 2 extra feed rollers
E	Electric motor
H,V	Horizontal / Vertical steam engine
T	Steam turbine

METRIC CONVERSIONS

Roll lengths and diameters

in.	mm	in.	mm
84	2 134	42	1 067
78	1 981	40	1 016
72	1 829	38	965
66	1 676	36	914
60	1 524	34	864
54	1 372	33	838
48	1 219	32	813
44	1 118	30	762
		28	711

Factory tch	Units of different design are listed in separate columns			
ML 225	1,2 (Dewater.) 2 134 × 1 067 38 40° 5R 1 067 1,2 T 560 31 4 500	Diffuser		
PG (150)	1 2 134 × 1 118 50 40° 4R 838 1,7 T 450 11 5 700	2–6 1 676 × 864 50 40° LFR 685 2 H 225 7 70	7 2 134 × 1 118 50 40° 4R 838 3/4, 5/6 H 300 7 70	(Diffuser will by-pass Nos. 2–5)
UF1 161	1–6 2 134 × 1 016 50 45° HFR 991 1–6 V 320 11 420	7 2 134 × 1 016 50 45° 5R 863 7 T 370 17 4 500		
UF2 80	1,2 1 676 × 864 50 45° LFR 838 1 H 140 7 60	Diffuser 2 H 140 7 60	3 1 676 × 864 50 45° LFR 813 3/4 T 370 9 4 000	4 1 676 × 864 38 45° LFR 838
EM 203	1 2 134 × 1 118 50 41° 4R 926 1 T 410 30 5 000	Diffuser 2,3,4 T 410 13 5 000	2 2 134 × 1 118 50 41° 4R 926	3,4 2 134 × 1 118 50 50° 4R 926
FX1 111	Crusher 1 829 × 927 50 40° LFR 686 Crusher H 300 7 60	1,3 1 676 × 927 50 40° LFR 610 1/2 E 300 3 300 735	2,4,5,6 1 676 × 927 50 40° LFR 533 3/4/5 E 450 3 300 735	6 H 300 7 60

Factory tch	Units of different design are listed in separate columns			
GH 242	1–2 2 134 × 1 118 63 35° 4R 840 1–7 T 480 27 5 700	3–7 2 134 × 1 118 50 35° 4R 840		
MV 77	1 1 829 × 965 50 55° LFR 762 1 T 335 16 4 500	2,3 1 676 × 890 38,50 45° LFR 610 2/3, 4/5 H 410 7 60	4 1 829 × 864 50 55° LFR 686	5 1 829 × 864 38 45° LFR 686
JB 200	1–6 2 134 × 1 194 50 45° HFR 838 1 E 710 6 600 1 470	2–6 E 650 6 600 1 475		
UC 60	1 1 981 × 914 25 45° HFR 762 1 T 280 17 5 000	Diffuser 2,3 T 205 17 4 500	2,3 1 524 × 762 38 45° LFR 762	
TS1 195	1 2 134 × 965 50 45° 5R 940 1 T 560 14 4 000	2–6 2 134 × 965 50 45° LFR 914 2–6 V 335 14 420	7 2 134 × 965 25 35° 5R 813 7 T 450 14 4 000	
TS2 98	1 2 134 × 1 067 25 35° 5R 1 067 1 T 560 14 4 000	2–6 1 676 × 914 50 45° LFR 762 2/3 T 335 14 4 000	4 H 260 7 50	5/6 V 280 11 350

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60	1 524	34	864
54	1 372	33	838
48	1 219	32	813
44	1 118	30	762
		28	711

Factory tch	Units of different design are listed in separate columns			
FX2 72	1–6 1 524 × 838 50 40° LFR 483 1 E 150 3 300 590	2/3/4 H 225 7 60	5/6 H 225 7 60	
EN 48	1 1 371 × 711 38 45° LFR 635 1 E 130 1 200	Diffuser 2/3 E 225 1 200	2 1 219 × 711 38 45° LFR 635	3 1 311 × 711 25 55° LFR 635
AK 306	1 2 134 × 1 143 50 35° 6R 915 1 T 560 30 5 700	2–7 2 134 × 1 143 50 35° 4R 915 2–7 T 480 30 5 700		
DK 72	1 1 676 × 900 50 55° — — 1,2/3,4/5,6 T 410 25 5 000	2,3,4,5 1 370 × 690 38/25 55° — —	6 1 676 × 900 25 55° — —	
GD 43	1 1 524 × 762 25 55° LFR 690 1 V 150 10 400	2,3.4 1 219 × 610 25 55° — — 2/3/4 H 300 7 60	5 1 422 × 711 25 55° LFR 540 5 T 150 14 3 000	
DL 208	1–6 2 134 × 1 067 50 46°/41° 4R 838 1–6 V 375 14 450			

Factory tch	Units of different design are listed in separate columns			
ME 186	1 2 134 × 1 041 50 40° HFR 927 1,7 T 450 10 4 000	2–5 2 134 × 965 50 40° HFR 927 2–6 E 315 525 495	6 2 134 × 965 38 40° HFR 927	7 2 134 × 1 016 38 55° 5R 838
IL 106	1 2 134 × 1 016 50 55° HFR 914 1/2 H 800 14 70	2–3 1 828 × 914 50 55° HFR 610 3/4, 5/6 H 650 8 45	4,5,6 1 828 × 914 50 45° HFR 610	
RN 75	1–3 1 676 × 914 50 45° LFR 762 1 T 260 11 —	4,5 1 524 × 787 25 45° LFR 762 2/3 T 460 11 —	4/5 H 205 7 60	
SZ 244	1–4 2 134 × 1 067 38 45° 5R 1 067 1–5 T 560 20 4 500	5 2 134 × 1 067 38 35° 5R 1 067		
UK 159	1–6 1 829 × 978 50 45° LFR 660 1–6 T 410 17 4 000			

mill cheeks. The pinions and gears (± 1,6 m diam.) are fabricated from five flame cut plates, each about 50 mm thick riveted together, to form a single gear. This factory has had excellent results using white metal mill bearings on cast iron housings. Amatikulu has installed a pressure feeder unit to its first mill driven by hydraulic motors mounted within the rollers. Hydraulic motors are also utilized in the Saturne diffuser dewatering rollers and final mill drive.

Mill grooving has moved away from 55° down to between 45° and 40°.

The use of scraper plates with cast teeth has been accepted generally.

Gledhow are successfully running slat type inter-carriers without tail shafts and sprockets by simply guiding the chains round semi-circular runner strips. Union Co-op has used some experimental high density plastic rollers instead of stainless steel in their slat conveyor feeding the diffuser.

Diffusers

A Saturne flooded diffuser was installed at Umfolozi in 1971. The unit is an annular box (12 m OD × 9 m ID × 4 m wide) designed to handle 150 tch. A series of carrier arms on a massive annular beam 1,5 m deep carries the bagasse through three quarters of a full circle while moving in a counter current juice stream. The drive is by a hydraulic piston.

An experimental single cell Fletcher and Stewart diffuser, after rigorous testing at Empangeni, is

DIFFUSERS

Factory	Make	Design throughput tch	Effective screen area m^2	Length m	width m	Outside diam. m	Inside diam. m	Cane crushed tch
ML	De Smet	225	160	33,2	7,0			225
PG	Fletcher & Stewart 5 cells	150		—	—			N.A.
UF	Saturne	150			4	12	9	80
EM	BMA 1 F & S cell	225	170	35,4	4,8			203
EN	De Smet	90	59	73,6	2,49			48
UC	BMA	108	48	28	2,2			60

JUICE HEATERS

Heating surface in m^2 100m^2 = 1076 ft^2

Not including Liquid to Liquid Heaters

Factory	Primary No.	Primary H.S.	Secondary No.	Secondary H.S.	Diffuser No.	Diffuser H.S.	Pre-evaporator No.	Pre-evaporator H.S.	Total H.S. m^2	Total m^2 /tch
ML	5	232			5	232	2	232	2 784	12,39
PG	9	93			1	300**			1 137	8,70
UF	4	139	2	232	3	93	2	167	2 245	9,71
			2	167						
			1	278						
EM	4	790			3	= 598	4	= 392	1 780	8,8
FX	1	325**	2P/S	136			2	136	1 141	6,25
			2	136						
EN	1	111	1	111	6	50	1	93	615	12,75
AK	3	204	3	204			3	204	1 836	6,00
DK	2	93	1	167			1	186	539	7,47
GD	2	93							278	6,42
	2	46								
DL	4	= 808					2	186	1 180	5,67
GH	10	186					2	209	2 278	9,40
MV	3	93								
	1	139							418	5,43
JB	3	232	4	232			1	232	1 856	9,30
UC	2	93			2	186	1	93	465	7,80
TS	3	175	4	186					1 827	6,24
	3	186								
ME	2	232	3	232					1 160	6,2
IL	2	102	1	186					664	6,28
	1	186	1	88*						
RN	1	204	2	149					919	12,23
	3	139								
SZ	7	204					2	697	2 822	11,61
UK	4	111	2	214					872	5,49

* not used **7m long tubes

achieving full operational status with a five cell installation (behind a single mill) at Pongola, due to be commissioned in August 1973: this mill cum diffuser will initially handle 150 tch. These units have a double perforated deck with chain driven slats moving the bagasse at about 3 m/minute, first down and then up the inclined decks under continuous sprays of recirculated juice. The bagasse blanket is about 0,5 m deep and is allowed to fall freely at each transfer point.

Compared with a milling tandem of equal capacity diffusers have three highly desirable characteristics, lower capital cost, high extraction and lower maintenance costs. Amatikulu is scheduled to install a cane diffuser for the 1974 season and a number of powerful mills will become redundant. One can foresee that pairs of these units (as dewatering mills) combined with other cane diffusers will be replacing existing old milling tandems very shortly. Not only will this reduce the maintenance costs associated with obsolescent plant but it can also provide a generous reserve of extraction plant capacity.

Juice heaters

Felixton and Pongola will each have a vertical heater with tubes 7 m long this season. This is a logical step to reduce capital cost and cleaning time.

Clarifiers

A 50% reduction in retention time has been achieved with slight modifications to existing Rapidorr clarifiers. An increase in the number of take-off points has resulted in clear juice being removed at double the previous rates possible with three or four off-take points. Three very large single clarifiers, 11 m in diameter, have been installed at Empangeni, Darnall, and Umzimkulu.

By using gravity mud take-off points, the use of mud pumps is being slowly discontinued. Tests are proceeding with pilot plant models of new clarifier designs and a full scale trayless clarifier is being built at Empangeni for commissioning this season.

Evaporators

The number of long tube (4 to 7 m) evaporators has increased from 8 to 13 during the period under review. The later vessels have all utilized a separate

CLARIFIERS

200 m³ = 7 063 ft³

G = Graver
B = Bach
D = Dorr multifeed
BMA = BMA
R = Rapidorr
R4 = Rapidorr 444

Factory	No.	Make	Diam m	Capacity m³	Total	Capacity/tch
ML	1	G	9,8	441,7	441,7	1,97
PG	2	D	6,1	= 291,6	804,1	6,15
	1	R	6,7	220,9		
UF	1	R	7,3	263,3	1 049,3	4,49
	1	R	7,9	369		
	1	B	6,7	171		
	1	B	6,1	125		
	1	B	5,4	121		
EM	1	R4	11,0	460,0	723,3	3,60
	1	R	7,3	263,3		
FX	1	D	5,5	147	557,0	3,05
	1	R	5,5	147		
	1	R	7,3	263		
EN	1	R	6,1	181,2	181,2	3,76
AK	4	R	7,3	= 1 050,6	1 050,6	3,43
DK	1	G	6,1	127,0	274,0	3,80
	1	R	5,5	147,0		
GD	1	B	4,9	68,0	249,2	5,82
	1	R	6,1	181,2		
DL	1	BMA	11,0	460,0	460,0	2,21
	3	B**	6,1	= 375,0		
GH	1	R	8,5	356,8	781,6	3,22
	2	D	7,3	= 424,8		
MV	2	D	5,5	= 294,5	294,5	3,82
JB	2	R	9,8	= 931,6	931,6	4,67
UC	1	BMA	4,0	25,5	206,7	3,50
	1	R	6,1	181,2		
TS	3	B	6,7	= 456,6	980,5	3,35
	2	R	7,3	= 523,9		
ME	3	R	7,3	= 787,2	787,2	4,23
IL	1	D	6,7	177,8	441,1	4,17
	1	R	7,3	263,3		
RN	1	D	6,1	147,2	263,3	3,50
	1	R	4,9	116,1		
SZ	2	D	6,7	= 356,8	767,4	3,15
	1	R	9,1	410,6		
UK	1	R4	11,0	460,0	460,0	2,90
	2**	B	4,3	= 98,3		

** Not in use.

EVAPORATORS

500 m² = 5 382 ft²

Factory	Heating surface in m² effect numbers 1	2	3	4	5	Total H.S.	H.S./ tch
ML	1 579	1 022	743	743		7 153	31,8
	1 022	1 022					
	1 022						
PG	929	465	465	465		4 834	37,0
	1 115	465	465	465			
UF	1 858	1 114	670[1]	670	670	8 419	36,4
	836	930	557	557	557		
		348[2]	348[2]	348[2]	348[2]		
EM	1 013	710	710	710	710**	6 280	30,9
	848	552	343	343	343		
FX	1 400	1 160	780	780	650	6 120	33,5
	700				650		
EN	743	232	232	325	325	1 857	38,5
AK	1 858			743		9 288	30,3
	743	743	743	743			
	743	743	743	743			
				743			
DK	279	143	143	143		2 101	29,1
	418	325	325	325			
GD	372	279	232	116		1 231	28,7
	116			116			
DL	1 394	817	817	817	817	7 804	37,5
	1 394	437	437	437	437		
GH	2 787	1 394	1 394	929		10 870	44,8
	2 787	929		650			
MV	870	216	216	216	321	2 703	35,1
		181	181	181	321		
JB	1 394	1 210	1 210	1 210		6 418	32,2
	1 394						
UC	836	279	279	279		1 673	28,1
TS	2 230	557	557	557	557	12 262	41,9
	2 230	372	372	372	372		
	929	557	557	557	557		
	929						
ME	2 508	929	743	743	743	6 491	34,9
	275	275	275				
IL	929	557	557	279		3 475	32,9
				279			
	279	279	158	158			
RN	697	348	348	348	348	2 833	37,7
		186	186	186	186		
SZ	1 394	650	650	650	650	8 173	33,5
	929	348	348	348	348		
	929						
	929						
UK	1 208	(Vapour cell)					
	603	416	416	416		5 641	35,5
	860	574	574	574			

[1]An extra 670 is spare [2]Not in use and not included in total H.S. **Internal condenser

entrainment separator vessel to facilitate cleaning operations by making the cover plate of the tube vessel firstly hinged and now completely removable by means of a bayonet type locking device. These ends and joints are designed to withstand 0,5 bar pressure of bled vapour for pan boiling and juice heating.

Both new Kestner pre-evaporators at Tongaat have a built-in heater involving an up and a down pass of a group of evaporator tubes. The need for a clear juice heater is thus eliminated. These two vessels are tubed with stainless steel tubes, one in Type 304 and the other in Type 430.

Vacuum pans

The installation of a built-in tray type barometric condenser in the vapour space of a pan is such a logical move that one can only wonder why it was not used years ago. The first pan was designed by Huletts and installed at Darnall.

Two 85 m^3 pans have been installed recently, one at Amatikulu and one at Gledhow. The downtake diameters are about 3 m and 100 mm diameter tubes have been used with a length of 800 mm.

A 42 m^3 A pan has been installed at Felixton on a self-supporting circular column which acts as a strike receiver for other pans as well. No grain segregation is reported.

Crystallizers

There has been a trend to operate crystallizers in series and these are shown in the plant table being marked with an "S" where applicable. Large gutters have been installed to ensure a series flow from vessel to vessel and a midway baffle ensures no short circuiting of massecuite flow across the top of the crystallizers.

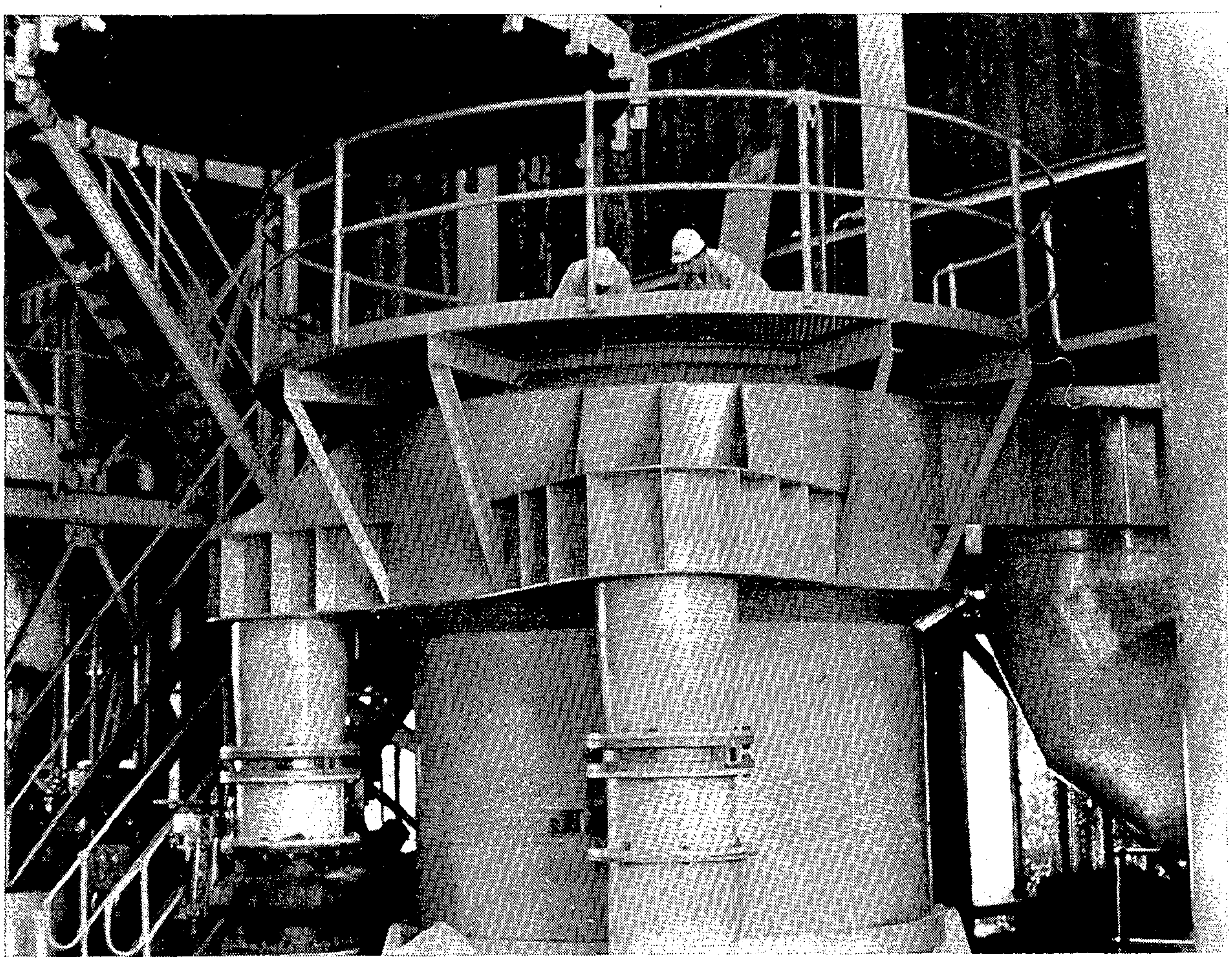
Drive of crystallizers by means of hydraulic pistons and suitable drive wheels together with finned tube cooling elements have been installed at some mills.

Gledhow is installing a common 170 m^3 strike receiver under its A pans this coming season.

Malelane is utilizing the series flow principle to solve a massecuite transport problem from pans to C centrifugals.

A new design of two vertical crystallizers utilizing a U-shaped flow pattern with two vertical vessels is being built for Renishaw C massecuites.

Reheating of C massecuite is still being carried out by fin-tube elements carrying heating water. Electric reheaters are not popular and only three are working,



Long tube evaporator at Amatikulu showing end cover removed for access to tube sheet. Steam inlets are shown at left and centre, with vapour outlet main and entrainment separator just visible at right.

ROTARY VACUUM FILTERS

E = Eimco OC = Oliver Campbell 50 m² = 538 ft³ Filters 2,44 m diam.

Factory	No.	Make	Per Filter Length m	Per Filter Area m²	Total area	m²/tch
ML	2	E	4,9	37,2	74,4	0,33
PG	2	OC	4,9	37,2	74,4	0,57
UF	3	OC	3,7	27,9	139,5	0,60
	2	E	3,7	27,9		
EM	3	OC	4,9	37,2	148,8	0,73
	1	E	4,9	37,2		
FX	5	OC	3,7	27,9	139,5	0,76
EN	1	OC	3,7	27,9	46,5	0,96
	1	E	2,4	18,6		
AK	4	OC	4,9	37,2	148,8	0,49
DK	2	OC	2,7	20,9	55,6	0,77
	1	OC	1,8	13,8		
GD	1	E	3,7	27,9	27,9	0,65
DL	4	OC	3,7	27,9	111,6	0,54
GH	5	OC	4,9	37,2	186,0	0,77
MV	2	OC	3,7	27,9	76,7	1,00
	1	OC	2,7	20,9		
JB	1	OC	4,9*	65,0	102,2	0,51
	1	OC	4,9	37,2		
UC	1	E	4,9	37,2	37,2	0,62
TS	5	OC	3,7	27,9	167,4	0,57
	1	E	3,7	27,9		
ME	4	OC	3,7	27,9	111,6	0,60
IL	2	OC	3,7	27,9	55,8	0,53
RN	1	OC	4,3	32,5	51,1	0,68
	1	OC	2,4	18,6		
SZ	4	OC	4,9	37,2	148,8	0,61
UK	2	E	3,7	27,9	83,7	0,53
	1	OC	3,7	27,9		

*Filter is 4,27m in diam.

PAN STORAGE TANKS

100 m³ = 3 531 ft³

Factory	Capacity in m³ Syrup	A mol.	B mol.	Total	Seed Receivers, Magma Mixers No.	Cap. each m³
ML	228	91	91	410	6	19,8
PG	261	102	113	476	1	17,0
					1	23,0
UF	139	87	71	297		
EM	246	104	104	454	2	25,5
					1	34,0
FX	116	82	85	283	3	28,3
EN	—	—	—	—	2	4,0
					2	8,5
AK	107	86	86	279	3	48,0
DK	68	57	47	172	2	14,0
			—		1	8,5
					1	13,0
GD	42	73	73	188	1	8,5
					1	12,7
DL	159	82	68	309	1	56,0
					2	23,0
GH	286	166	117	569	1	56,0
					2	30,0
MV	62	62	62	186	6	13,0
JB	200	100	100	400	6	31,1
UC	65	43	33	138	3	25,5
TS	145	66	60	271	1	20,0
ME	102	102	102	306	1	17,0
					1	22,7
					1	26,9
IL	—	—	—	—	—	—
RN	119	93	61	273	1	10
					1	17
SZ	317	159	238	714	1	34
					1	42
UK	132	88	88	308	1	34

all at Entumeni. The two techniques should be used together.

Centrifugals

Continuous machines have virtually made a clean sweep in the curing of C massecuites. Throughputs of 1 m³ per hour are being achieved compared with 1,8 m³ in Australia and Mauritius. The massecuite viscosity ranges are similar despite popular opinion that ours are above their ranges. Whether viscosity is the sole criterion for this comparatively lower throughput remains an open question, but it is one which is also related to recovery.

There are many B continuous machines in service and even with crystal breakage these B sugars are being used as magma for the footings of A boilings.

Umfolozi installed a battery of 6 batch machines to handle their low grade products.

Sugar driers

A new Roto-louvre type sugar drier driven by motor tyre type suspension, doing away with the noisy rollers and gear or chain drive, has been installed at Jaagbaan.

Boiler plant

The only major installation in this department has been at Tongaat, where a 36 000 kg/h Thomson

VACUUM PANS

Factory	A No.	A Cap. m³	A H.S. m²	B No.	B Cap. m³	B H.S. m²	C No.	C Cap. m³	C H.S. m²	Total Capacity	Capacity m³/tch
ML	3	42,3	237	2	42,3	209	1	42,3	181*	338,4	1,5
	1	42,3	181*				1	42,3	209		
PG	1	34,0	214	1	31,1	197	1	31,1	197	221,1	1,7
	2	31,1	197				1	22,7	113		
							2B/C	20,0	87		
UF	1	45,3	269	1A/B	45,3	278	1	22,7	149	339,5	1,5
	2	36,8	223	1	42,3	220	2	45,3	223		
				1	22,6	148	1B/C	42,4	223		
EM	1	42,3**	252	1	51	302	1	22,7	135	302,6	1,5
	1	51 **	325				1	42,3	223		
	1	51	288				1	42,3	216		
FX	2	42,5**	250	1	42,5**	241	1B/C	34,0	190	255,0	1,4
	1	34,0	177				1	34,0	190		
	1	25,5	130								
EN	1	25,5	158	1	25,5	153	1	12,7*	70	113,0	2,3
	1	15,3	79	1	25,5*	134	1	8,5	46		
AK	3	42,3	251	2	42,3**	251	2	42,3**	209	381,1	1,2
	1	85**	511								
DK	3	19,3	136	2	12,7	67	1	26,6	153	109,9	1,5
GD	1	20,4		3B/C	9,1					70,4	1,6
	1	22,7									
DL	1	42,3	247	1	28,3	167	1	28,3	177	284,8	1,4
	1	51,0**	268	1	28,3	177	1	28,3	167		
	1	50,0					1	28,3	139		
GH	1	85**	488	3	36,8	223	3	36,8	223	418,8	1,7
	2	56,5	372								
MV	1	34,0	173	1	34,0	150	1	34,0	150	161,4	2,1
	2	17,0	67								
	2	12,7	37								
JB	4	42,3	251	2	42,3	251	2	42,3	209	338,4	1,7
UC	2	25,5	147	1	25,5	147	1	25,5	147	102,0	1,7
TS	6	28,3	145	3	28,3	160	3	28,3	121	339,6	1,2
ME	2	51**	318	1	45,3	295	4	28,3	173	349,7	1,9
	1/HTM	43,9	253	1	45,3	245					
IL	2	28,3		1	31,1		1	31,1		232,0	2,2
	2A/B	31,1					1	34,0			
							1	17,0			
RN	2	24,9**	111	1	22,7	111	1	24,9	111	118,6	1,6
	1	21,2	93								
SZ	4A/B	42,3	223	2	28,3	158	3	28,3	158	341,8	1,4
							1	31,1	186		
UK	2	42,5	223	1	42,5	223	1	42,5*	223	257,9	1,6
	1	22,7	195	1B/C	42,5	223	1	22,7	139		

* Stirrer equipped pan
** Internal condenser

ft.³	m³
2 000	56,6
1 600	45,3
1 500	42,3
1 200	34,0
1 000	28,3
800	22,7
600	17,0

boiler was installed in 1971 to replace three old Stirling boilers. This unit has a Thomson furnace based on the Jaagbaan design and has a generous capacity for overload. Tongaat uses belt conveyor bagasse transport in the boiler house and has installed highly effective vibrating screen units for the recovery of bagacillo for byproduct use.

There will be seven flue gas scrubbers in operation this season and each year more will be installed until all stacks can meet the particle emission level of 450 mg/m^3.

Power generating plant

Doornkop installed a new turbo-alternator and standby diesel plant.

Water pollution

Various types of water purification plant including biofilters, aerobic and anaerobic ponds, spray irrigation schemes, etc. have been installed to return purified or semi-purified water to the river or lands. Umfolozi has installed two Paasveer ditches, one for sewage and one for factory waste water which comply fully with the provisions of the return water specifications.

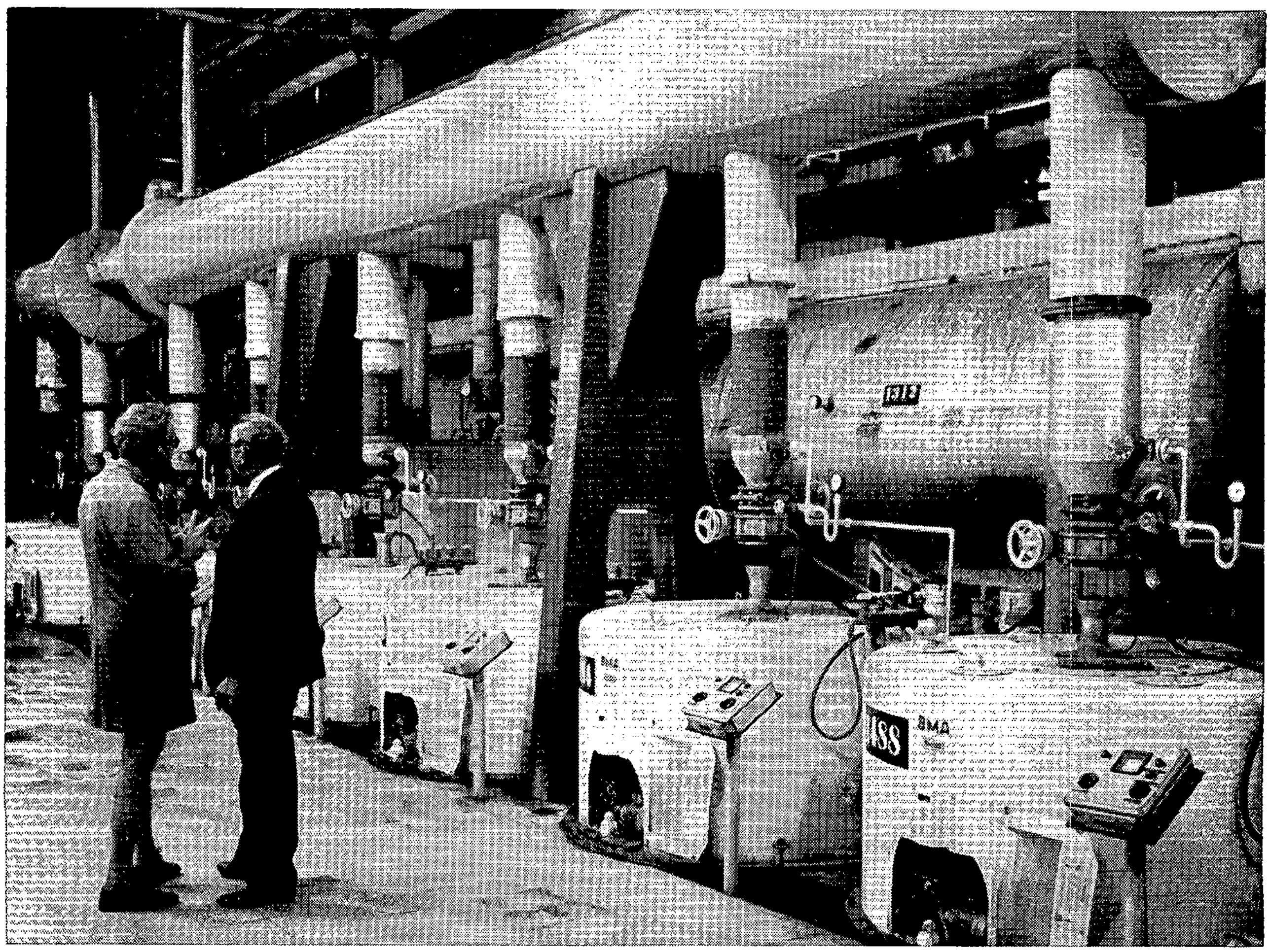
Factory nomenclature

A key to the factory code letters used in the tables is given below. The listing is in geographic order from North to South.

ML	Malelane	GH	Gledhow
PG	Pongola	MV	Melville
UF	Umfolozi	JB	Jaagbaan
EM	Empangeni	UC	Dalton (Union Co-op)
FX	Felixton	TS	Tongaat
EN	Entumeni	ME	Mount Edgecombe
AK	Amatikulu	IL	Illovo
DL	Darnall	RN	Renishaw
DK	Doornkop	SZ	Sezela
GD	Glendale	UK	Umzimkulu

Conclusions

Cane preparation, milling versus diffusion and shorter clarification periods are under close scrutiny, continuous pan boiling and high grade centrifuging are somewhat further off but improvement in low grade centrifuging capacity is an immediate requirement. Replacement of existing plant, costly in maintenance, by reliable virtually maintenance-free equipment must be the final objective. Before long, the



Battery of continuous machines at Sezela illustrating continuation of clean lines and spacious layout which was started with the Darnall 'C' station.

shortage of natural fibre in this country may necessitate substitution of coal for bagasse in our boiler plant while the fibre is used in byproducts. High thermal efficiency in processing will be our next priority and vapour 3 bleeding must no longer be left to the distant realms of beet sugar technology.

It is gratifying to see that more attention is being paid to the broader principles of unit process technology rather than the well-tried but rather narrow so-called sugar engineering of the past.

Acknowledgements

Thanks are extended to all factory and central technical personnel for their co-operation in supplying gaps in the published data and to Mr. P. de Robillard (SMRI) for his willing assistance in compiling the tables.

REFERENCE

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CENTRIFUGALS

	A					B				
Factory	Make	No.	Speed rpm	Diam. mm	Depth mm	Make	No.	Speed rpm	Diam. mm	Depth mm
ML	WS	5	1 000	1 372	1 016	WS Co	4	2 200	864	34°
	?	1		1 340	830					
PG	B	5	1 500	1 067	762	B	4	1 500	1 067	762
UF	WS	10	1 500	1 220	762	WS	4	1 500	1 220	762
EM	B	8	1 200	1 220	762	BMA Co	4	2 200	850	
FX	B	5	1 500	1 220	762	BMA Co	3	2 200	850	
						WS Co	1	2 200	865	34°
EN	B	3	1 500	1 067	762	B	1	1 500	1 067	762
						B	2	1 500	1 067	610
AK	B	14	1 500	1 220	762	BMA Co	6	2 200	850	
DK	WS	3	1 450	1 016	762	WS	2	1 450	1 016	762
GD	ASEA	1	1 200	1 220	762	WS	1	2 200	1 220	762
DL	B	7	1 500	1 220	762	BMA Co	4	2 200	850	
GH	B	13	1 000	1 220	762	BMA Co	6	2 200	850	
MV	B	3	1 500	1 067	762	B	3	1 500	1 067	762
JB	BMA	6	1 450	1 220	762	BMA	6	1 450	1 220	762
UC	B	2	1 500	1 067	762	B	3	1 500	1 067	762
						AC Co	1	2 200		
TS	ASEA	8	1 300	1 220	762	BMA Co	6	2 200	850	
						HL Co	5	2 200	582	34°
ME	B	9	1 500	1 067	610	BMA Co	4	2 200	850	
IL	PC	1	—	1 067	762	WS	4	1 400	1 067	762
	WS	4	1 500	1 016	762					
RN	B	4	1 500	1 067	762	B	3	1 500	1 067	762
SZ	B	4	1 500	1 220	762	B	5	1 500	1 220	762
	BMA	2	1 500	1 340	830					
UK	B	5	1 500	1 067	762	B	3	1 500	1 067	762
	WS	1	1 000	1,200	762					

in.	mm
54	1 472
48	1 220
42	1 067
40	1 016
34	864
30	762
24	610

Co = Continuous
AC = Allis Chalmers
ASEA = ASEA
B = Broadbent
BMA = BMA
PC = Pott Cassels & Williamson
WS = Western States Machine Co.
HL = Hein Lehamann

CENTRIFUGALS *(continued)*

	C. Foreworkers					C Afterworkers				
Factory	Make	No.	Speed rpm	Diam. mm	Depth mm	Make	No.	Speed rpm	Diam. mm	Depth mm
ML	WS Co	8	2 200	864	34°					
	? Co	3	2 200							
PG	B	8	1 500	1 067	762	B	2	1 500	1 067	762
UF	WS	6	1 500	1 372	1 016	AC Co	4	2 200		
EM	BMA Co	12	2 200	850		BMA Co	3	2 200	850	
FX	B	16	1 500	1 067	610	B	3	1 500	1 067	610
EN	B Co	3	1 800	36	30°					
AK	BMA Co	15	2 200	850		BMA Co	6	2 200	850	
DK	WS	4	1 350	1 016	762	HL Co	2	1 500	762	30°
	WS Co	1	2 200	864	34°					
GD	WS Co	2	2 200	864	34°					
DL	BMA Co	10	2 200	850		BMA Co	4	2 200	850	
GH	BMA Co	12	2 200	850		WS Co	3	2 200	864	34°
						BMA Co	1	2 200	850	
MV	WS Co	4	2 200	864	34°					
JB	BMA	11	1 720	1 220	762	BMA Co	3	1 750	1 000	
	BMA Co	3	2 200	850						
UC	AC Co	4	2 200	800	475					
TS	BMA Co	15	2 200	850						
ME	B	3	1 500	1 067	610	B	5	1 000	1 067	610
	ASEA	6	1 700	1 220	762					
IL	ASEA	4	1 800	1 220	762	WS Co	2	2 200	865	34°
	WS	2	1 700	1 016	762					
RN	B	3	1 500	1 067	762	B	1	1 500	1 139	762
SZ	BMA Co	12	2 200	850		BMA Co	3	2 200	850	
UK	WS Co	10	2 200	865	34°	WS Co	2	2 200	865	34°
						AC Co	1	2 200	686	34°

in.	mm
54	1 472
48	1 220
42	1 067
40	1 016
34	864
30	762
24	610

Co	= Continuous
AC	= Allis Chalmers
ASEA	= ASEA
B	= Broadbent
BMA	= BMA
PC	= Pott Cassels & Williamson
WS	= Western States Machine Co.
HL	= Hein Lehamann

CRYSTALLIZERS

W = Water cooled S = Series connected Cap. in m^3

Factory	A No.	A Cap.	B No.	B Cap.	C No.	C Cap.	Total	Cap/tch
ML	8	42,3	1	108	1	108		
			4S	42,3W	12S	42,3W	1 231,2	5,48
PG	6	17,0	7	17,0	20	17,0W		
					6	31,1W	747,6	5,72
UF	4	45,3	10	25,4	7	25,4	997,4	4,31
	8	25,4			4	45,3W		
EM	8	30,8	13	30,8	7S	44,0W	954,8	4,70
FX	1	99,5	9	14,2	8	34,0W	598,5	3,3
	1S	56,6						
	3	14,2						
EN	2	19,8	5	8,5	5	12,7W	264,6	5,49
	1	17,0	3	25,5	1	25,5W		
AK	12	46,4	8	44,4W	16S	44,4W	1 622,4	5,30
DK	8	9,9	7	12,7	6	28,3W	337,9	4,7
			1	9,9				
GD	3	20,4	4	9,9	4	9,9	180,0	4,20
					4	9,9W		
DL	5S	28,3	9S	28,3	15S	28,3W	820,7	3,94
GH	3S	56,6	9S	36,8	4S	36,8	1 531,4	6,32
	3S	56,6	3S	36,8	7S	56,6W		
	1	170,0						
	1	36,8						
MV	8	17,0W	2	34,0W	5	34,0W	408,0	5,30
			2	17,0W				
JB	6	42,3	6	42,3W	18	42,3W	1 269	6,36
UC	3	25,5	3	25,5W	5	25,5W	331,5	5,56
TS	5	28,3	7	28,3	8S	28,3W	849,0	2,90
					10	28,3W		
ME	4	28,3	4	28,3	16	28,3W	1 018,8	5,47
	6S	28,3	6S	28,3				
IL	4	34,0	4	34,0	8	34,0W	612	5,79
					2	34,0W		
RN	3S	24,1	4S	24,1	1	48,2	361,5	4,81
					4S	56,6W		
SZ	8	42,3W	8	42,3W	4S	28,0W	1 353,6	5,57
					8S	28,3W		
					8S	28,3W		
UK	3	45	4	45	8S	42,3W	710,2	4,46
	2	22,7						

$ft.^3$	m^3
2 000	56,6
1 600	45,3
1 500	42,3
1 200	34,0
1 000	28,3
800	22,7
600	17,0

BOILERS

10 bar = 145 psig

B = Bi-drum CTM = Cross-tube marine WIF = Wrought Iron Front S = Spreader D = Dutch Oven T = Thomson C = Cyclone SC = Spray Chamber IS = Scrubber

Factory	No.	M.C.R. kg / h x 1 000	Type	Press. bar	Temp. °C	Heating surfaces					Furnace type	Grit arrestor	Accumulator		Total installed kg / h x 1 000	Installed capacity / tch kg/t cane
						Convection m²	Furnace m²	S / H m²	Econ. m²	Air H. m²			No.	Cap.kg/h x 1 000		
ML	3	45	B	31	400	1 228	*	*	270	724	S	C	—	—	135	601
PG	2	23	B	13,8	260	581	*	73,6	—	405	S	Nil	2	11	90	688
	4	17	B	11	260	515	*		—	358	S	Nil				
UF	1	57	B	31	400	1 450	153	233	—	976	S	C	2	11	207	895
	2	27	B	13,8	260	650			—		S	C				
	2	14	CTM**	13,8	260	461	—		—		D	C				
	1	14	WIF	11	260	478	—		—		D	C				
	2	20	WIF**	11/13,8	260	680	—		—		S	C				
	1	14	B	13,8	260	481			—	228	S	IS				
EM	1	45	B	31	370	854	*	116	1 261	504	S	C	2	23	155	763
	1	31	WIF	14,3	288	1 031	—	110	—		D	SC				
	1	23	B	13	204	752	*	51	—		S	SC				
	4	14	WIF	10	204	681	—	56	—		D	SC				
FX	1	45	B	31	370	854	110	116	1 261	504	S	C/SC	—	—	129	706
	1	45	B	13,8	277	967	369	106	121	502	S	C/SC	—	—		
	1	16	WIF	7	170	373	—	—	—	185	D	SC				
	1	23	WIF	13,8	200	681	—	—	—	200	D	SC				
EN	3	7	WIF	10,3	200	279	—		273		D	Nil	—	—	44	912
	1	23	B	17	330	675	62		51	388	S	C				
AK	4	36	B	31	370	609	*	95	878	471	S	C	2	20	144	470
DK	1	21	B	25	370	744	*		—	529	T	Nil	—	—	58	804
	1	11	WIF	10	220		—		—	406	D	Nil				
	3	7	WIF	10	220	257	—		—	—	D	Nil				
	1	5	WIF	14	220	229	—		—	—	D	Nil				
GD	1	14	WIF	13,8	316	497	—		232	400	S	Nil	—	—	21	490
	2	7	WIF	10	185	340	—	—	—	153	D	Nil				
DL	1	45	B	31	370	854	*	116	126	504	S	C	2	17	155	745
	2	32	WIF	13,8	277	1 030	—	205	—	650	D	Nil				
	1	23	WIF	13,8	277	681	—	153	—	664	D	Nil				
	1	23	B	31	345	671	*	*	—	228	S	Nil				

*Included in convection surface area.
**Not in use.

BOILERS 2

10 bar = 145 psig

B = Bi-drum CTM = Cross-tube marine WIF = Wrought Iron Front S = Spreader D = Dutch Oven T = Thomson C = Cyclone SC = Spray Chamber IS = Scrubber

Factory	No.	M.C.R. kg / h x 1 000	Type	Press. bar	Temp. °C	Heating surfaces Convection m²	Heating surfaces Furnace m²	Heating surfaces S / H m²	Heating surfaces Econ. m²	Heating surfaces Air H. m²	Furnace type	Grit arrestor	Accumulator No.	Accumulator Cap.kg/h x 1 000	Total installed kg / h x 1 000	Installed capacity/ tch kg/t cane
GH	1	45	B	27,5	370	774	142	137	373	1 560			2	27	194	800
	1	45	B	27,5	370	1 106	217		—		S	C				
	1	34	CTM	27,5	370				—		S	C				
	1	34	CTM	27,5	370				—		D	Nil				
	2	18	WIF	13,8	320		—		—		D	Nil				
MV	1	23	B	17	320	581	*	142	—	732	S	Nil	—	—	56	727
	1	14	B	11	300	310	*	85	680	452	S	Nil				
	1	7	WIF	10	200	373	—		—	}	D	Nil				
	2	2	WIF	10	200	118	—		—	} 1 280	D	Nil				
	1	4	WIF	10	200	235	—		—	}	D	Nil				
	1	4	WIF	7	170	235	—		—	}	D	Nil				
JB	3	45	B	31	400	1 779	*		—	1 176	T	Nil	—	—	135	676
UC	1	23	B	17	282	781	*		196	388	S	C	—	—	37	620
	1	14	WIF	11	188		—	—	—	—	D	Nil				
TS	1	36	B	14	340						T	IS	2	24	212	725
	2	32	WIF	13,8	340	1 030	—			1 670	D	Nil				
	1	23	CTM	14	340						S	IS				
	1	27	B	14	340	698	*				S	IS				
	3	9	WIF	11	260	341	—				D	SC				
	5	7	5Drum	11	260	372	—				D	SC				
ME	1	27	B	13,8	240					487	S	C	2	12,5**	152	816
	5	25	WIF	13,8	240	770	—	184	—	465	D	Nil				
IL	1	25	B	31		800	*				S	C			92	870
	5	9	WIF	11		445	—				D	Nil				
	2	11	CTM	13,8		558	—				D	Nil				
RN	1	23	B	11	218						S	U			56	745
	3	11	WIF	11	218		—				D	SC				
SZ	2	57	B	21	330	1 488	381	128	483	823	S	C	3	16,3	222	910
	3	18	B	12	243	558	*				S	C				
	3	18	B	12	243	558	*				S	Nil				
UK	1	41	CTM	17	260	1 179	—				D	Nil			96	604
	1	14	WIF	17	260	465	—				D	Nil				
	2	16	CTM	17	260	474	—				D	Nil				
	1	9	WIF	7		418	—				D	IS				

*Included in convection surface area.
**Not in use.

POWER PLANT

Factory	Alternators		Steam conditions			Diesel sets		Voltage Generation V	Installed steam power MW	Installed steam power tch. kW/t cane
	No.	Capacity kW	Inlet press bar	Temp. °C	Exhaust press. bar	No.	Capacity kW			
ML	2	6 400	31	400	1	Nil		6 600	19,2	85,4
	1	6 400	31	400	1/cond.					
PG	1	2 000	13,8	260	0,7	2	400	3 000	3,7	28,3
	1	1 100	13,8	260	0,7	1	125			
	1	600	13,8	260	0,7					
UF	1	6 000	31	400	1	1	1 000	3 300	6,0	25,9
	*1	2 500	13,8	260		3	250	500		
	*2	1 000	13,8	260				500		
EM	1	3 000	12,8	280	1,4	1	350	3 300	4,75	23,4
	1	1 000	11							
	2	750	11							
FX	1	4 000	31	370	1,0	1	120	3 300	7,0	38,3
	1	3 000	13,8	277		1	150			
		—				1	350			
EN	1	1 500	17	330	0,8	1	100	550	1,95	40,4
	1	450	11,5	330		1	75	400		
AK	2	4 000	31	370	1	1	350	6 600	8,0	26,1
DK	1	1 000	25	370	0,5	1	200	500	2,5	35,0
	1	750	10	220		1	125			
	1	774	12,4	220		1	300	415		
GD	1	1 250	13,8	316	0,5	2	200	11 000	1,7	39,7
	2	300	10	185				500		
	1	150								
DL	1	2 000	31	370	13,8	1	600	3 300	7,0	33,6
	1	3 000	13,8	277	1	1	290			
	1	2 000	13,8	277	1					
GH	1	5 400	27,5	370	1/cond.	1	300	3 300	9,65	39,8
	1	2 750	27,5	370	1			3 300		
	1	1 500			1			500		
MV	1	2 000	17	260	1	1	210	500	3,04	39,4
	3 =	1 035	10	186	0,3					
JB	2	5 000	31	400	1	2	400	6 600	10,0	50,1
						1	100			
UC	1	1 200	17	282	0,8	1	50	380	1,2	20,1
	*1	320								
TS	1	3 000	13,8	260	0,8	Nil	—	6 600	10,5	35,9
	1	3 000	13,8	260	cond,			6 600		
	3	1 500	10	245	0,8			550		
ME	1	3 000	13,8	240	1,2	1	300	2 200	9,08	48,8
	2	2 025	13,8	240	1,2/cond.					
	1	2 025	13,8	240	1,2					
IL	1	3 500	31	370	0,8	Nil		6 600	5,0	47,2
	1	1 500	11	260				500		
RN	3	600	11	218	0,6	1	180	500	1,8	23,9
SZ	3	1 000	12	240	1	1	800	3 300	6,75	27,7
	1	3 750	21	330						
UK	1	2 000	17		0,7	1	200	400	3,1	19,5
	1	1 100				1	125			

All factories distribute at 550/500 volts except: UK = 400 volts.
UC = 380 volts.

* Not in use.