REINHOLD HEMPELMANN, BMA AG, P.O. Box 3325, 38022 Braunschweig, Germany.
Successful Introduction of a new generation of Batch centrifugals.

1 Introduction

Undoubtedly, batch centrifugals are employed whenever the demands made on the quality of the sugar are very high. Therefore, manufacturers are under a continued challenge to increase the capacity, to facilitate and simplify their installation and operation as well as to reduce maintenance requirements of their machines.

As the result of a re-engineering process, BMA recently introduced its new B-series batch centrifugals. The essential new features are:

1. Ideal basket height to diameter ratio resulting in extremely smooth centrifugal operation
2. A new design discharger, which is equal in length to the full height of the basket, reducing discharging time and adding 2 full charges per hour more.
3. A new design syrup separator resulting in optimal separation of green syrup.

Driving and control equipment were optimized by developing an own integrated control software and hardware. A new ultrasonic massecuite feed sensor using ultrasonic technology was successfully operated during the campaign 2000.

Until now 89 centrifugals of the new B-series have been sold and 64 already delivered.

2. Design features

Since the introduction of this new centrifugal in 1998 to the sugar industry a large demand from many customers was experienced to expand the range of capacities of the new B-Series. The new range of B-series centrifugals (Tab.1) consists of the standard type B1300, B1750 and B2200 with a max. massecuite layer of 230 mm. For special applications the new types B1100, B1500 and B1900 were introduced with a max. massecuite layer of 195 mm and an increased max. gravity factor.

Type		**B 1100 (new)**	**B 1300**	**B 1500 (new)**	**B 1750**	**B 1900 (new)**	**B 2200**
Capacity/charge	(kg)	1,100	1,300	1,500	1,750	1,900	2,200
Basket volume	(t)	725	830	964	1,107	1,189	1,370
Max. mcte layer	(mm)	195	230	195	230	195	230
Max. speed	(rpm)	1,250	1,200	1,133	1,080	1,075	1,030
max. gravity factor	(g)	1,179	1,087	1,105	1,004	1,098	1,008
Center distance	(mm)	1,750	1,750	2,300	2,300	2,300	2,300

Tab. 1: New range of B-series centrifugals

Centrifugal basket

In recent years, centrifugal basket volumes have been continuously increasing due to market requirements. The massecuite capacity of a centrifugal basket is arrived at by the basket volume plus the additional volume that can be purged due to the prepurging effect during filling. Practical experiences have proven that the prepurging effect is limited only by the flow resistance inside the sugar layer when a bridge type backing screen is used. The flow resistance is determined by the viscosity of the mother liquor as well as the MA and the CV of the crystal sugar and the crystal content.

In general it can be said that in the purging of even crystals for both white and raw sugar a gravity factor of approximately 1000 to 1100 is sufficient. The layer thickness should not exceed 230 mm – especially for fine sugar, since the gaps between such crystals provide more resistance to syrup drainage.

Some suppliers manufacture baskets with an height / diameter ratio of 0.8 and over and, in addition to that, make an attempt to provide the missing volume by a thicker crystal layer. These slim baskets have a substantially inferior vibration stability and are therefore less reliable. BMA considers a basket height / diameter ratio of max. 0.76 and a layer thickness of 230mm (9") as optimum in terms of smooth and stable centrifugal operation.

Discharger

There are only a few possibilities to shorten the **cycle time** of a batch centrifugal without compromising the quality of the sugar. The development concentrated on two areas:

- Shortening the discharging time by introducing a full height plough
- Reducing the braking time by optimizing the control and the frequency converter.

The new discharger (Fig. 1), available for B1750(1500) and B2200(1900), is a completely new invention.

Its actuating and control elements for vertical and horizontal movement are provided outside the basket, protecting them from incrustations and resultant wear. The vertical movement takes place in rail-bound carriers which allow an exact and easy adjustment of the discharger plough to the basket. As those parts which require regreasing do not extend into the basket, the discharger is almost maintenance free.

During the discharging process the basket spindle is held in place by a ring device provided with rollers which slide on a bush attached to the spindle. An air cylinder moves this arrangement into position during discharging process only; this prevents oscillations, ensures safe and gentle removal of the sugar from the basket and provides an almost completely clean screen after every cycle.

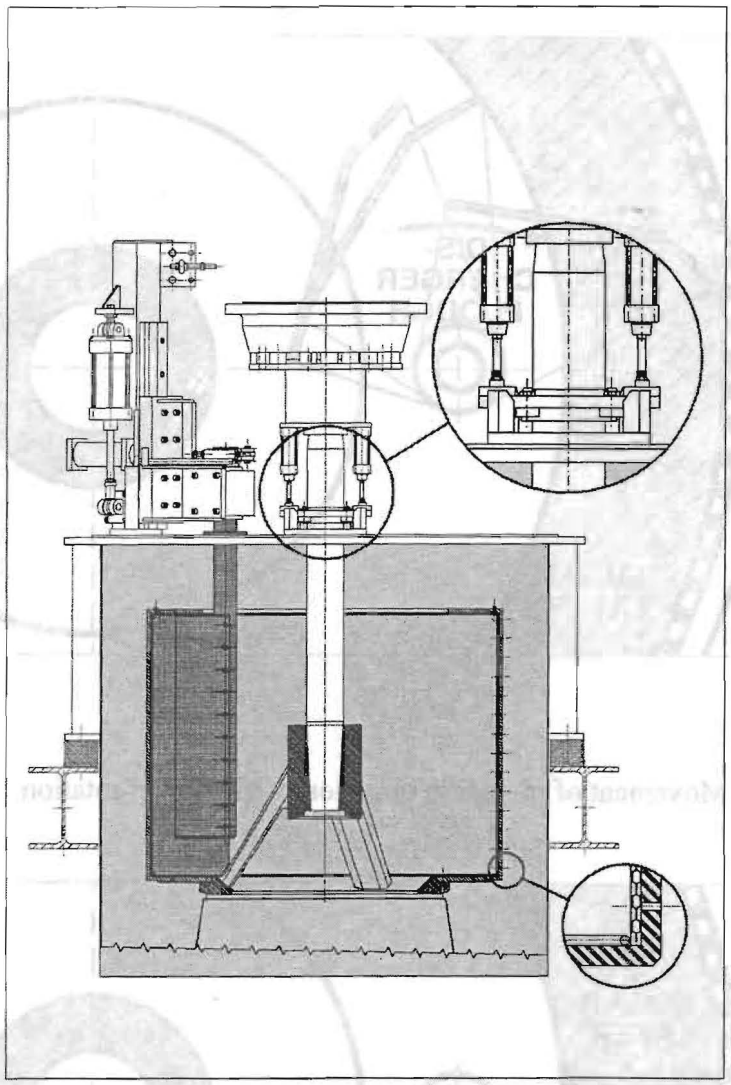

Fig. 1: Discharger arrangement

The new plough has the same height as the basket, eliminating vertical movement within the basket and resulting in a considerable reduction of the discharging time. The plough moves into the sugar layer in the direction of the basket rotation (Fig. 2). The results achieved with this new plough proved that the discharge time can be reduced by up to 20sec/charge, which means adding 2 full charges per hour more.

A plough which moves into the sugar layer against the direction of basket rotation (Fig. 3), similar to that of the previous G machines, is a standard for the B1300(1100) and also available for all other types of the B-series. Owing to the smaller dimensions of the B1300(1100), the advantage of the long plough is not as significant as for the bigger machines. Therefore the decision for design and construction of a long plough for the B1300 was postponed.

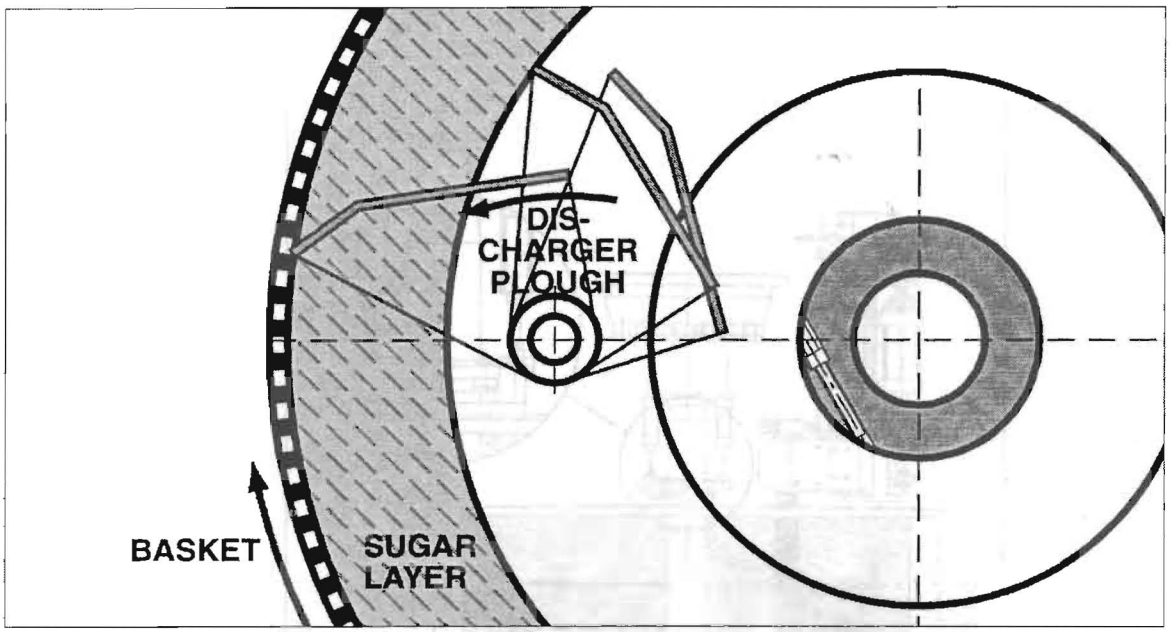

Fig. 2: Movement of plough in direction of the basket rotation

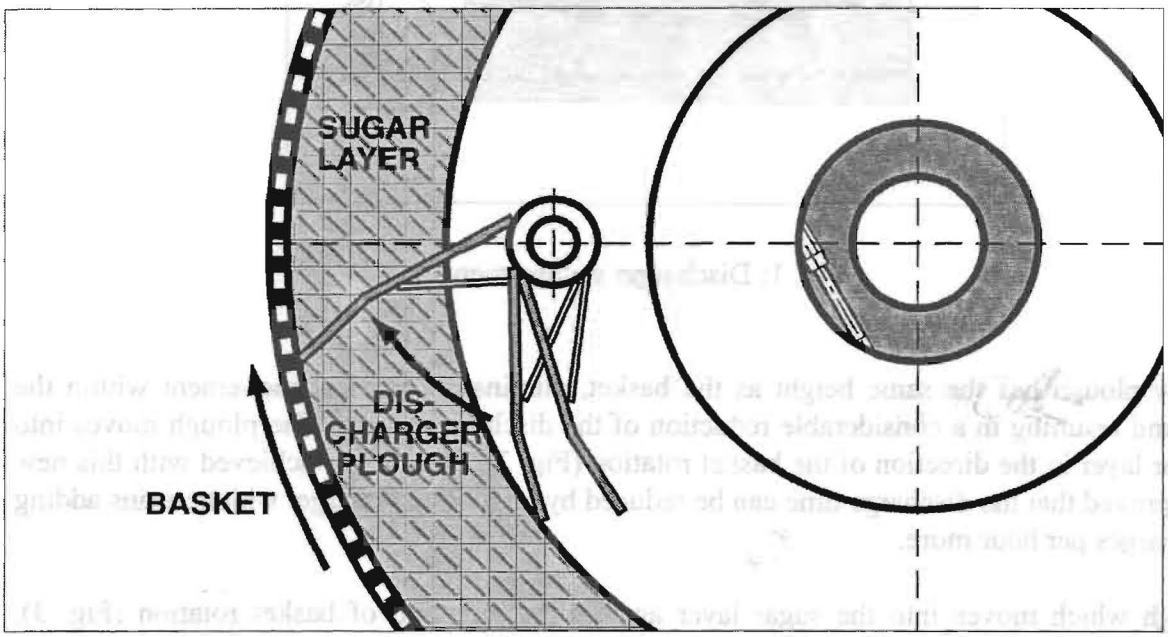

Fig. 3: Movement of plough against direction of basket rotation

Screens

In the new design a cover screen with a small overlap is used being held in place by thin clamp rings. This design permits easy and quick replacement. The cover screen has a thickness of 0.6 to 0.8mm and 0.5mm diameter holes, or 0.35 to 0.4 mm slots providing an open screen area of 19% to 23% . the backing screens provide a large clearance between the basket and the cover screen and are of the proven bridge-type which enables a fast syrup drainage.

Discharge valve

The novel discharge valve lowering device (Fig. 4) consist of an air cylinder attached to the spider and a stainless-steel hood attached to the piston rod. The compressed air used has a pressure of approximately 6 bar.

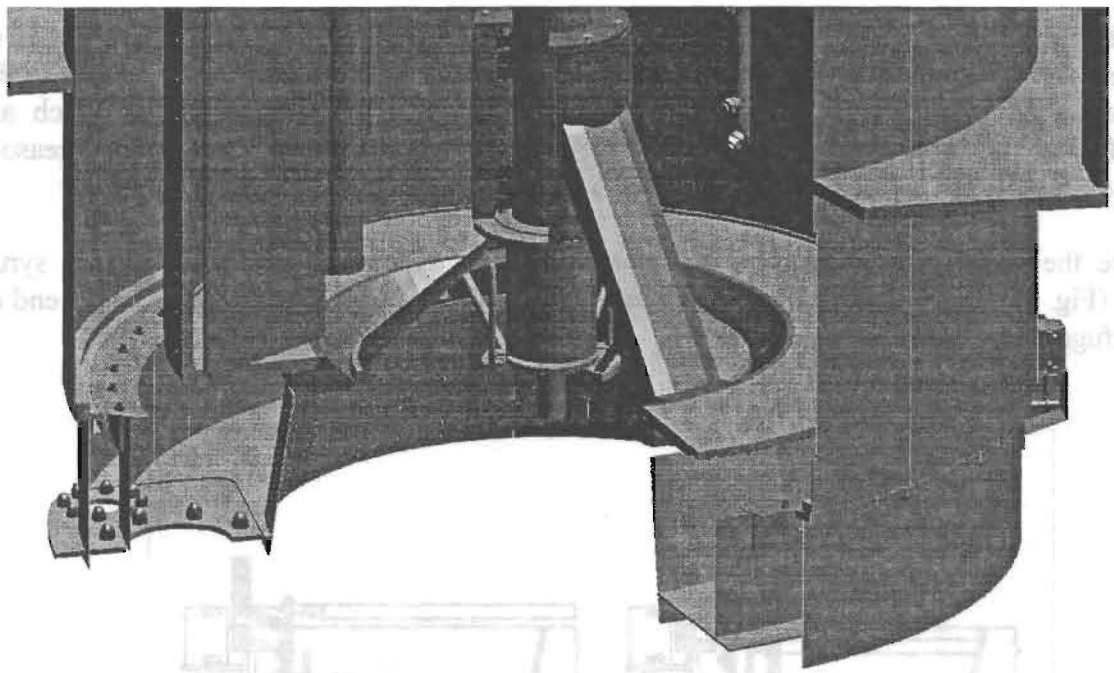

Fig. 4: Discharge valve and syrup separator

Ultrasonic sensor for massecuite/sugar layer

A new ultrasonic sensor using ultrasonic technology was successfully operated during the full beet campaign 2000. The design includes a standard sensor in combination with a mirror system. This system provides an interesting alternative to the mechanical sensor as permanent ultrasonic measuring of the massecuite layer thickness will allow conclusions on the massecuite properties. For example, the changes in the layer thickness during a centrifugal cycle can be used for setpoint adaptation in the next cycle. R&D investigations are being carried out at present.

Syrup separator (Fig 4)
Syrup separation can have a significant impact on the efficiency of the sugar house, therefore it is common practice at many beet sugar and also some other factories to separate the syrup into green and wash syrup. The separation process comprises two phases:

- syrup separation for rapid removal of the syrup (mainly mother liquor) from the massecuite
- washing the sugar layer directly after syrup separation with water

Separation of "green" and "wash" syrup should of course be as complete as possible: the green syrup should be nothing but mother liquor of the massecuite and the wash syrup should be nothing but enriched wash water to avoid purity and color overlaps. Hitherto, syrup separation (or rather the changeover from green to wash syrup) after the centrifugal was done by valves fitted in the syrup outlet pipes.

One must bear in mind, however, that after spinning off the green syrup and at the beginning of water washing there are still considerable quantities of green syrup left on the lower wall of the centrifugal housing, on the bottom plate and in the pipes to the shutoff valve, which are prevented from flowing off quickly due to the turbulences inside the machine. For this reason, there always remains a certain quantity of mixed green and wash syrups.

To reduce the mixed syrup quantity, the new centrifugal is equipped with a built-in syrup separator (Fig. 5) which allows changeover from green to wash syrup already at the lower end of the centrifugal housing wall.

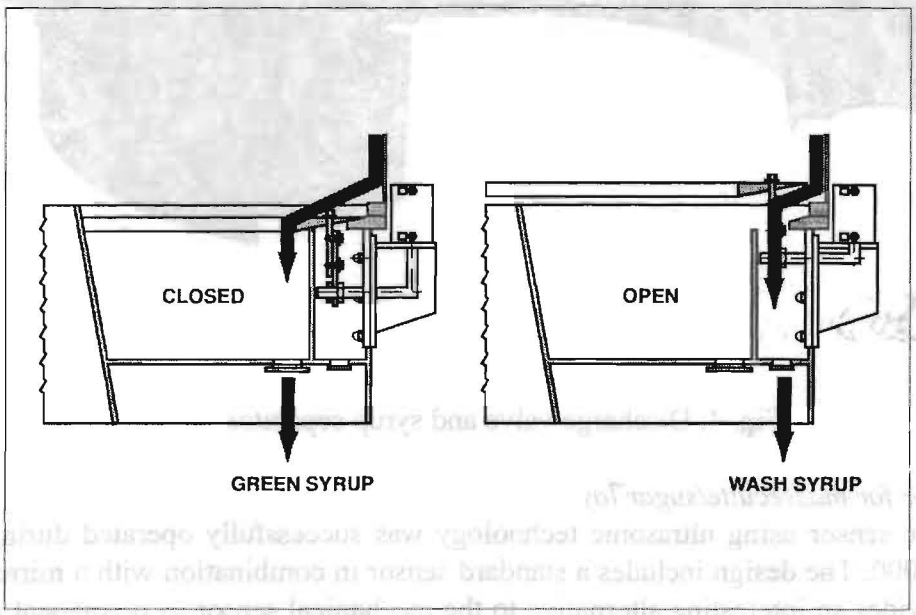

Fig. 5: Principle of syrup separator

Screens

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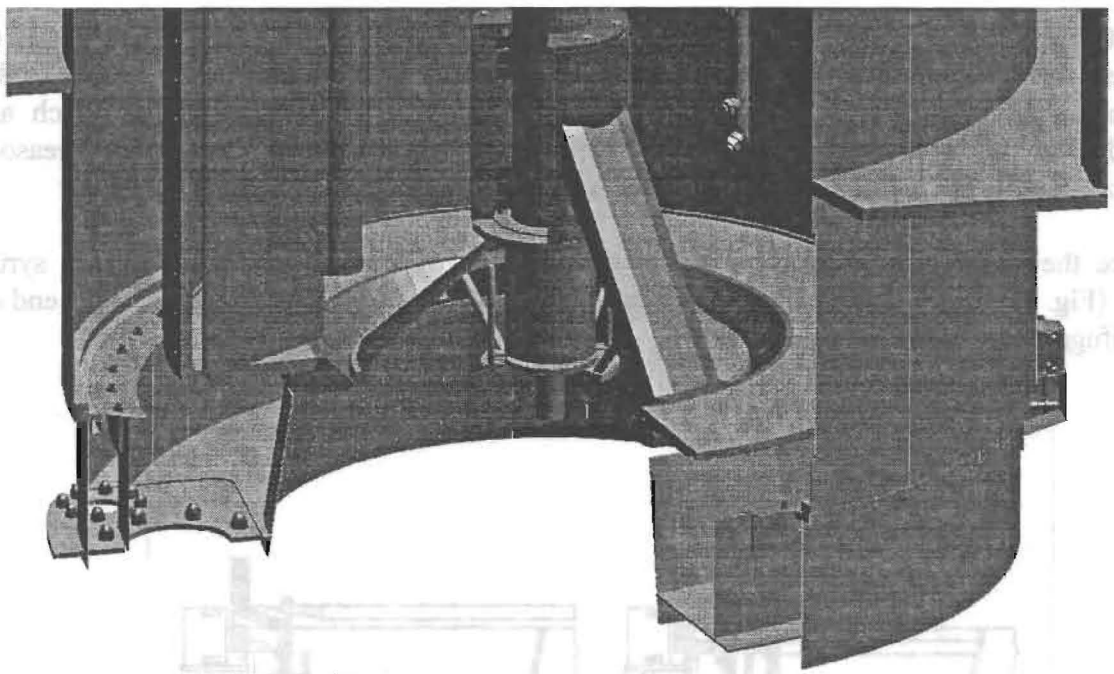

Fig. 4: Discharge valve and syrup separator

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The essential component of this facility is a ring plate inside the housing, which, when pneumatically closed, directs the green syrup into an inner outlet duct and when lifted up conveys the wash syrup into an outer duct. This reduces the mixture of green and wash syrup and therefore increases the purity difference between the two syrups.

The new syrup separator was tested at one centrifugal for A massecuite. Fig. 6 shows the centrifugal speed and syrup purities over one complete cycle of operation. During this tests the centrifugal was operating at an average of 23.7 charges/h. Washing started at 700 min^{-1} with a duration of 24s being equivalent to 34.3liters wash water .

Case I: First the syrup purity over a complete cycle without syrup separation was determined. In the beginning the purity reaches is highest level when the screen is washed. Then it drops due to the drainage of the mother liquor from the massecuite with the centrifugal coming to speed. Once the mother liquor has been replaced by the wash water applied during sugar wash there is a steep increase in purity until it finally levels off.

Case II shows the purity of the separated wash syrup when the separation takes place at the end of the washing cycle. The samples were taken at the outlet of the wash syrup channel. A certain effect of some mixed syrup can be seen at the beginning but the purity soon reaches the high level.

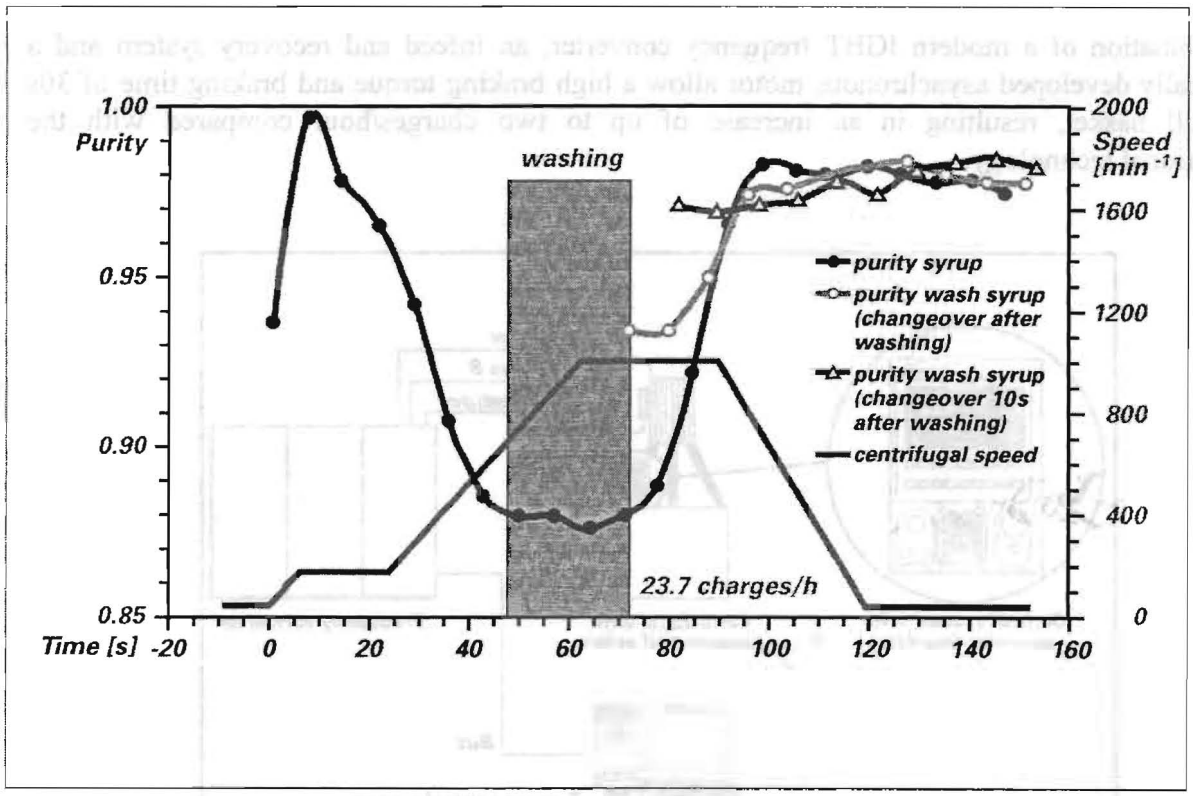

Fig. 6: Syrup purities with new syrup separator

Case III: The syrup separation was activated 10s after the end of the sugar washing. Here is practically no impact from impurities from mixed syrup visible.

Considering this improved separation technique the overall sugar house balance of a beet factory will show a higher sugar yield, a reduced molasses output and energy saved due to reduced mass flow in the crystallization of B-massecuite. The load of the B-pans can be reduced, resulting in additional capacity.

3. New drive and control concept

Centrifugal drive
As a major manufacturer of centrifugals, our company co-operates with all reputable makers of centrifugal drives. At the time commissioning it is therefore necessary in most cases that a drive specialist be present besides a BMA centrifugal specialist.

To reduce the costs involved in such assignments, BMA has decided to offer both services from one single source. A joint effort of BMA and Wittur (former Struckmeier), an innovative company which is specialized in high performance drive systems resulted in a complete new centrifugal drive (Fig.7).

A combination of a modern IGBT frequency converter, an infeed and recovery system and a specifically developed asynchronous motor allow a high braking torque and braking time of 30s with full basket, resulting in an increase of up to two charges/hour compared with the conventional technology.

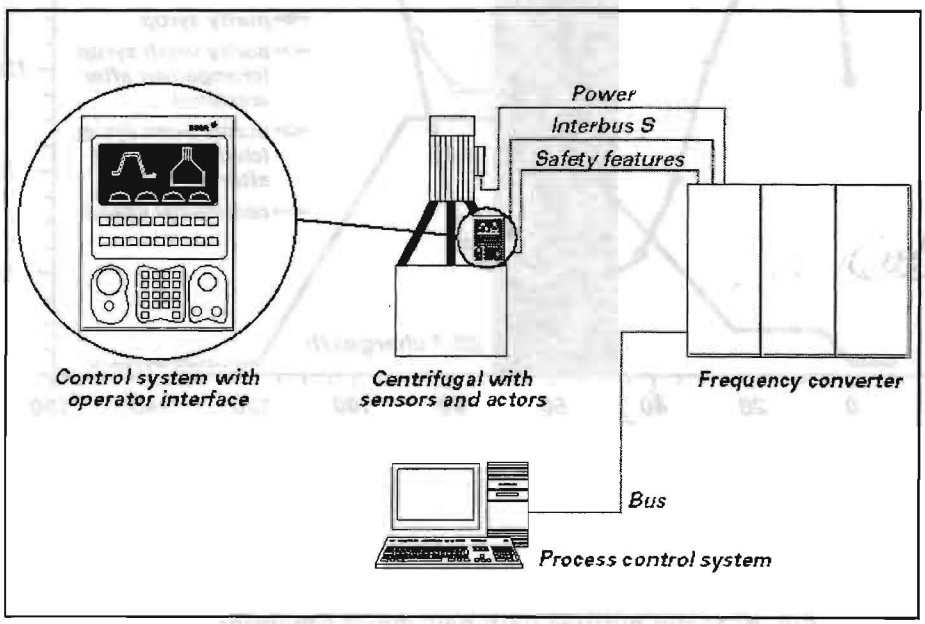

Fig. 7: Drive and control concept

Control panel
To date, conventional programmable control systems are mostly installed in a control room together with the frequency converters. Besides the limited performance of these programmable controls with regard to their operator interface, extensive installation work has to be done by the customer and several days of commissioning work are costly side effects.

Together with the new model B-series centrifugal BMA introduced it's own centrifugal control. It is based on an industrial PC and offers an unparalleled ease of control and operation combined with vast diagnostic features like speed/time diagram, a list with state of all sensors and valves and a memory for the last 100 errors. With detailed information about the state of the machine when error occurred. Operators reported this to be very helpful in day to day operation.

Drive and control concept
The connection with IGBT frequency converter is now realized with significantly reduced wiring. This has been made possible by utilizing an Interbus connection for the communication between the control and the frequency converter. Only some safety features and the power connections are wired separately.

After their completion at the manufacturers workshops, the machines will be in an operative condition, allowing them to be subjected to functional tests as part of the manufacturers quality control. What is left to be done at the customers's site is only to install the power cables and make a few control connections.

4. Maintenance (Tab. 2)

Component	*Disassembly*	*Inspection/ Repair*	*Cleaning*	Frequency
Drive	*-/x*	*x/x*	*-/x*	***1a / 3a***
Drive head with bearing housing	*-/x*	*x/x*	*-/x*	***1a / 3a***
Brake system	*-/x*	*x/x*	*x/x*	***1a / 3a***
Discharger system	*-/x*	*x/x*	*x/x*	***1a / 3a***
Bottom hood, centering facility	*-/x*	*x/x*	*x/x*	***1a / 3a***
Spindle and basket	*-/x*	*x/x*	*x/x*	***1a / 3a***
Feeding system	*-/x*	*x/x*	*x/x*	***1a / 3a***
Syrup separator	-	*x*	*x*	***1a***
Basket housing	-	*x*	*x*	***1a***
Pneumatic system	-	*x*	-	***1a***
Control system	-	*x*	-	***1a***
Washing system	*x*	*x*	*x*	***1a***

Tab. 2: Maintenance schedule

The design of BMA centrifugals and especially of the new B-series minimizes maintenance requirements and facilitates repair work. During operation of the machines grease needs to be applied once a week. As all their product-contacted parts are in stainless steel, there is no danger of corrosion, and components are practically maintenance free.

The table provides a general view of the components and the associated maintenance tasks. Another column lists the intervals required for maintenance work.

5. Results in practical operation

The combination of the BMA control with its optimized software, a modern IGBT frequency converter and matching AC motor shortened the braking time by 10s. The discharging time with the full height plough was reduced by 15s. The influence of these improvements is summarized in Tab. 3, showing data from recent commissioning of a B1750.

Action	**Time**
Screen wash and charging	18 s
Accelerating to spinning speed	37 s
Spinning	30 s
Breaking to discharging speed	29 s
Discharging and accelerating to charging speed	29 s
Total cycle time	**143 s**
equivalent to 25.2 ch/h	

Tab. 3: Cycle time data for B1750

All our customers confirmed the smooth and stable centrifugal operation in terms of high vibration stability.

Conclusions

The following is a summary of the main features and advantages incorporated in the new line of BMA B-series centrifugals:

- Normal charge mass of up to 2.200 kg charges
- High throughputs at a small layer thickness (230 mm or 195 mm), providing excellent technological results under a wide variety of operating conditions
- Novel discharger - short discharging period and minimized maintenance
- New syrup separator for maximum purity in wash syrup
- Spindle (basket) fixed during discharging for smooth and gentle discharge
- Cover screen without lock-lap joint
- Downward opening closing valve equipped with novel, almost wear-free actuator
- Design and construction complying with the world's most stringent safety regulations
- Optimized basket diameter to height ratio for extremely smooth operation
- Machines completely shop-assembled and tested to save time and cost for installation at site
- excellent price/performance ratio

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