# What Operators Always Desired – the Innovative Light Weight Plastic Segment for Big Diameter Disc Filters

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**Abstract**

With the introduction of the Boozer disc filter more than two decades ago BOKELA, Germany have set a new standard in seed filtration with decisively improved filter capacity and reduced maintenance and operation cost. Based on this comprehensive operational experience with numerous filter units and based on the operators feedback this modern big diameter disc filter has been upgraded to reduce cost and weight and to improve the high standards operators associate with this filter type. A core element is the light weight filter segment with only 9.6 kg in weight made of polymer which significantly facilitates re-clothing for the convenience of the operators. With change from metal segments to light weight polymer segments the design of filter discs also changed to a spoke wheel design. After an extended test operation, the new light weight filter segment is now ready for industrial application. The paper presents the new light weight filter segment, the construction of the new spoke wheel disc design and reports on the experience of more than 20.000 h of test operation.

**Keywords:** Seed filtration, disc filter, lightweight filter segment, filter reclothing, maintenance.

## 1. Introduction

Big diameter disc filters are the most advanced filter technology for seed filtration which were developed and installed for the first time in the early 70's. With the Boozer disc filter BOKELA have developed a new generation of big diameter disc filters which set a new standard for coarse and fine seed filtration. Now, BOKELA have redesigned and upgraded this disc filter type. Based on 25 years of operational experience with numerous filter units in many alumina refineries worldwide but also in other industries the design of this disc filter has been modernized to make this successful filter type fit for future with a new type of filter segment for easy and safe exchange of filter cloth.

## 2. Modern Disc Filters of Big Diameter

Beginning with the first supply of the Boozer disc filter units in 1995 BOKELA started a new era for high performance disc filter in seed filtration. In the meantime, Boozer disc filters are operated for fine seed, coarse seed and even for coarse product filtration in numerous Alumina refineries but also for applications in other industries worldwide.

Based on the experience gained in more than 250 filter optimisation / revamping projects for all major filter types of various OEMs, the Boozer established a new standard for disc filters incorporating a number of innovative changes to conventional design practice. Most of these innovations have been made to resolve capacity and performance problems related to hardware bottlenecks and/or poor hardware design of vintage disc filters but also to ease maintenance and exchange of filter cloth. The outstanding hydraulic characteristics of the Boozer disc filter were achieved by improving each detail of the vacuum disc filter design such as the number of filter discs and segments, filtrate pipes, centre barrel and bearings, filter trough, control head and cake discharge.

This has led to the following results (Hahn et al, 2002):

- low wear metal segments with massive hydraulic capacity to process the large filtrate flow
- metal segments of only 19.5 kg with quick release bayonet connections without tie rods
- quick fit filter bag system with cable ties
- filter designed to use poly bags which are easier to replace and more cost effective,
- permanent walkways between the discs to allow easy access to replace segments with torn cloths
- centre barrel and bearings designed for the high loads encountered with high capacity and high speed
- gearbox and motor designed for high loads at low speeds
- filter trough designed to eliminate agitators by being self-agitated
- level control system to prevent any overflow back to feed tank
- control head with low pressure losses (low wear) at high capacities, and
- back suck on the filter cloth to prevent damage on the scrapers during cake discharge.

Consequently, all the above changes have resulted in:

- extraordinary high-performance capacity
- drastically improved cake pickup due to the high vacuum achieved inside the disc
- better cake moistures than other filters of the same area at the same tonnage
- excellent discharge of the cake with 95 to 100 % reporting to the product
- vacuum always being at appropriate performance level
- high operational safety and reliability
- low maintenance and operation costs.

## 3. Innovative Features of the New Generation of Disc Filters

After 25 years of operational experience with numerous filter units in many alumina refineries the concept of the Boozer disc filter has been redesigned and upgraded to make this successful filter type fit for future and to present a better solution with respect to the weight of the filter segments.

It was the target to improve the high standards operators associate with the Boozer by simultaneously reducing cost and weight. Motto of the new design was “high performance for less money”. The following targets have been the guideline for the new design:

- high – i.e. same or even increased – performance capacity
- light filter segment made of polymer considerably below 15 kg
- reduction of total weight of a filter unit
- further improvement of filter operation and maintenance
- significant cost reduction

### 3.1 Modifications and Technical Data

To achieve this aim the proven and successful Boozer filter design has been enhanced by a series of new design features and improvements such as:

- new filter segment made of plastic with only 9.6 kg in weight which facilitates segment lifting significantly and reduces the risk of injury
- modifications in trough design to improve operation and to reduce cost and weight

Technical data of the Boozer L-type (big diameter filter) with polymer segments are shown in Table 1.

**Table 1. Technical data of the big diameter filter Boozer L- type with polymer segments.**

| | |
|---|---|
| No. of discs/unit | 2 - 4 |
| filter area per disc | 40 m² |
| filter area: polymer / metal segment | 80 m² – 160 m² |
| disc diameter | 5450 mm |
| rim diameter | 5600 mm |
| No. of polymer segments/disc | 30 |
| Weight of polymer segment | 9.6 kg |
| filter speed | 0.2 – 5 rpm or 6 rpm* |
| submergence of disc | 50 % |

*depending on installed gear

### 3.2 New Light Weight Filter Segment of Polymer

The new light weight filter segment is made of a polymer. This novelty is a new solution of an old problem and the response to a long-time objective of operators which have always desired a filter segment with less than 15 kg to facilitate easier handling during re-clothing. With only 9.6 kg in weight the new BOKELA polymer filter segment is even considerably below this target mark.

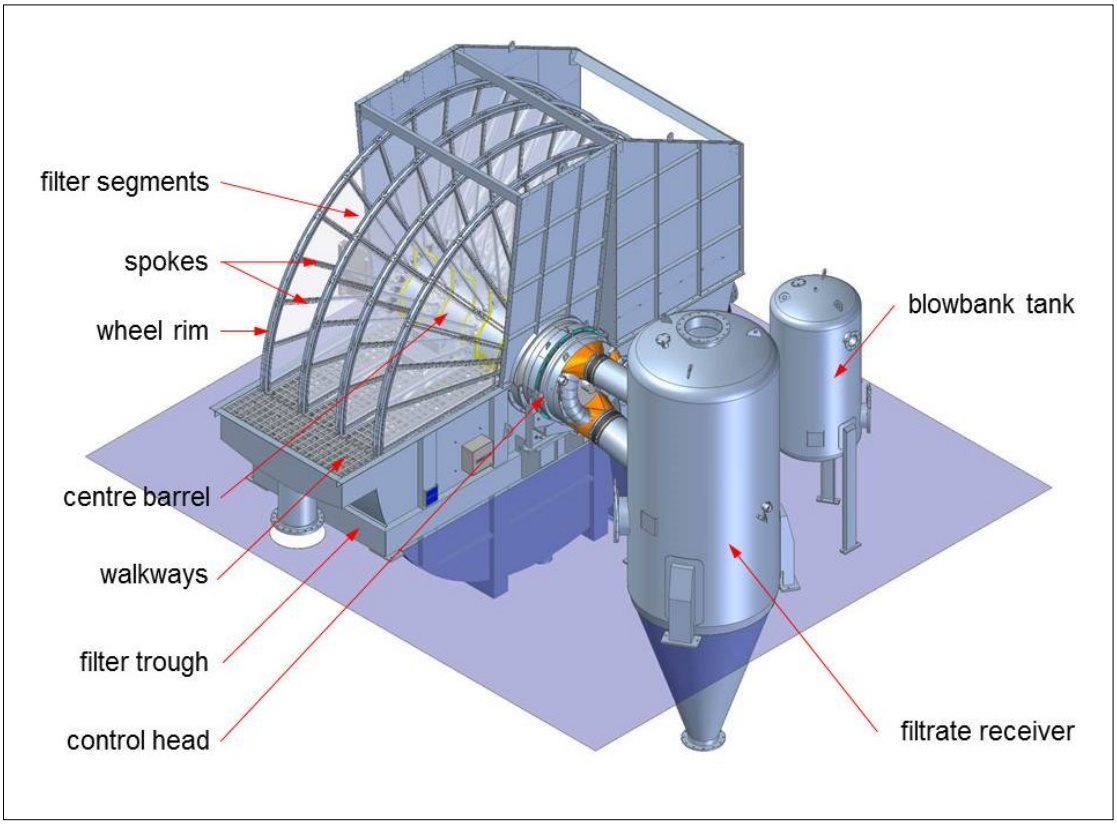


**Figure 1. View of the big diameter filter Boozer L- type with innovative polymer segments.**

The introduction of the Boozer light weight metal segments with 19.5 kg compared to 28 – 35 kg per segment of first big diameter filters was a progress with respect to operator convenience. However, this weight may easily increase up to 22 – 23 kg per segment with the filter cloth

mounted and internal scale build up. This means a severe health and safety issue for the maintenance people having to lift the segments when change of filter cloth is required.

Now, with the new polymer segments the weight of a segment is reduced by 50 % to 9.6 kg. This enormous weight reduction could only be realized by a change from metal to a polymer as the main material of construction.

While the metal segments have an optimised design with regards to the internal hydraulics, the lowest possible weight and stability and lifetime respectively, the design of the new polymer segments follows the philosophy of a segregation of functions.

With change to polymer as material of construction the duty of the new segment is to ensure low weight for the convenience of the operators and excellent internal hydraulics to provide for fast filtrate drainage which is decisive for enabling a high filter performance. Stability of the filter disc, however, is achieved by a spoke wheel construction which holds the filter segments and which provides for the alignment and concentricity of the filter disc during operation.

**Figure 2. Light weight polymer filter segment.**

The main characteristics and benefits of the new polymer segment can be summarized as:

- light weight of only 9.6 kg
- excellent internal hydraulics
- segment has not to take up any forces except to withstand pressure differences during filtration and compressed air blowback during cake discharge

- mounting and dismounting of segments nearly without tools
- ease of re-clothing by light weight and easy mounting leading to improved acceptance by operators and improved maintenance
- reduced cost per unit

### 3.3. Filter Disc

Each filter disc consists of 30 polymer segments which are fixed through a spoke wheel which holds the filter segments. Beside holding the segments, the function of the spoke wheel is to provide for the alignment and concentricity of the filter disc during operation.

Rigidity and concentricity of the filter disc is a basic necessity for trouble free operation and high performance due to following process requirements and mechanical requirements:

- for ensuring 100 % cake discharge each filter disc has to pass the discharge scrapers as close as possible what requires rotation with high degree of accuracy
- the disc has to withstand:
  - flow forces caused by the slurry inflow into the trough
  - shear forces caused by the disc rotation
  - load from filter cake and filtrate
  - momentum/vibrations from compressed air blowback during cake discharge.

The spoke wheel has a self-supporting construction forming trapezoidal spaces for the segments. It consists of following components:

- radial spokes incl. mechanical brackets for segment adjustment during assembly
- rim composed of single elements to connect the radial spokes at the outer radius
- spoke supports at the barrel circumference to connect barrel ports to the segments.

The spoke wheel is assembled and adjusted during filter installation and needs no further work then. During filter operation only, the segments have to be mounted and dismounted for re-clothing.

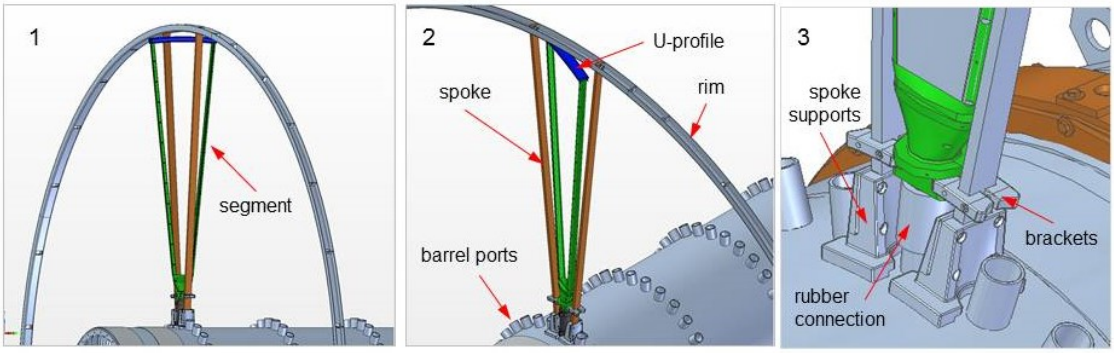


**Figure 3. Spoke wheel construction and mounting of a segment (1: plug in of segment to barrel ports, 2: turning of segment through 90°, 3: segment in end position)**

The segments are placed between the trapezoidal spaces of the spoke wheel as shown in Figure 3. Mounting of a segment is easily done in 3 steps without need of special tools: The segment is plugged in one of the rubber connections to the barrel ports for which it is in a position at right angles with the rim. The segment is then turned through 90° until it is in the correct position given by the segment brackets of the spoke supports. Following, the segment is fixed to the rim and held in position via clamp springs which are attached to the U-profiles made of polymer material which also serve for sealing of the filter bag at the brought end of the segment (Figure

4).

### 3.4. Operational Experience with the New Design at Alcoa Wagerup Refinery

The new design of the filter discs and the new light weight polymer segments have been tested at Alcoa Wagerup Refinery. For this test operation a Boozer L4 has been equipped with one disc of new design and polymer segments (Figures 4, 5 and 6). After more than 20 000 h of operation the operators are more than satisfied with the new design. The new filter disc is absolutely steady and runs accurate without any wobbling, the formation and dewatering of the filter cake on the new polymer segments is excellent and filter discharge is 100 %.

**Figure 4. Fixation of segment to the rim via clamp springs (during test operation).**

**Figure 5. Spoke wheel construction**

**Figure 6. Spoke wheel with polymer segments in operation (cake discharge)**

## 4. Conclusion

Boozer disc filters are operated for more than 25 years in numerous Alumina refineries for fine seed, coarse seed and even for product filtration but also for applications in other industries worldwide. Based on this comprehensive operational experience with numerous filter units and based on the operators feedback this modern big diameter disc filter has been redesigned and upgraded to reduce cost and weight and to improve the high standards operators associate with this filter type.

A core element is the light filter segment made of polymer with only 9.6 kg in weight which significantly facilitates re-clothing for the convenience of the operators. With change from metal segments to light weight polymer segments the design of filter discs also changed to a spoke wheel design.

Further design modifications refer to the design of the proven “joint-single” trough leading to a reduction of weight from 17 t to 12 t.

## 5. References

1. J. Hahn, R. Bott, T. Langeloh, 2002, “New performances in seed filtration by modern disc filters: a feasibility review”, *6th Alumina Quality Workshop*, Brisbane, Australia