The use of shearer drums when working to the dip

By Dipl.-Ing. Gerhard Hebel

At Reden colliery of the Saarbergwerke AG the majority of seams are worked to the dip. In these faces the loading action of the shearer drums is very much more difficult than in level faces. Cylindrical drums are inadequate in their loading capability in faces worked to the dip. For this reason different types of shearer drums have been developed in recent years and tested with the aim of improving loading capacity. None of the shearer drums introduced made for any appreciable improvement. But numerous discoveries were made which contributed to the development and construction of a new shearer drum; the Globoid drum.

Difference between cylindrical and globoid drum

In the case of the cylindrical drums (Figure 1, left) the helices are set at right angles on a cylindrical or truncated-cone central body. The turns of the helix when unwound would form a straight line. The product broken out by the picks collects in the interstices and is displaced in axial direction by the helix side which is moving in direction of the product during revolution and then discharged.

With this type of shearer drum the clearance volume between the helices remains constant from the coalface side to the discharge side. A slight volume increase towards the discharge side occurs only with shearer drums with a truncated cone central body. As the quantity of mined product is largest at the drum discharge side, the clearance volume between the helices is often not sufficient, so that product build-up occurs, thereby reducing the loading capacity of the shearer drums. Larger rock or coal lumps may also become wedged between the helices which are set vertical to the central body and so impede the loading out of the debris.

In the Globoid drum (Figure 1, right) loading capacity is improved by an interaction of several design features. For one. the helix pitch rises progressively towards the drum discharge side. The intervals between the helices have a cross-section which is half elliptical and half circular. Changes at the basic body and the continuous rising pitch of the helices make the clearance volume permanently larger towards the discharge side. This prevents product build-up. The rounded cross-section between the helices prevents any jamming of rock or coal lumps. The mobility of the product between the helices is improved, friction reduced and its disposal accelerated.

Introduction at reden colliery

In the past the N-l face in Aster seam started up with a double-drum shearer with two 1800 mm diameter cylindrical drums. The face had to be worked diagonally to the dip, it had a total thickness of 2.07 m and an average dirt content of 23.2% (Table 1). Later the first Globoid drum was fitted to the left-hand ranging arm (downhill side) of an EDW-300 LE shearer from Gebr. Eickhoff Maschinenfabrik und Eisengießerei mbH (Figure 2). According to the first reports of the face-winning team the loading capacity of this shearer drum was

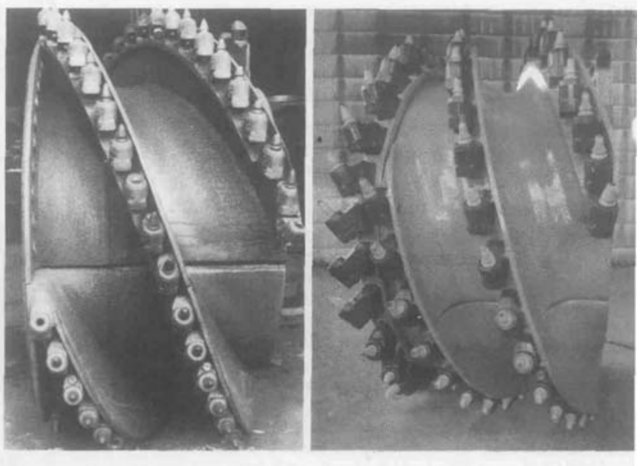

Figure 1. Cylindrical drum (left) and Globoid drum from Krummenauer GmbH & Co. KG.

The author is operations engineer at Reden colliery

obviously better than that of the cylindrical drum, still in use on the right-hand ranging arm on (uphill side). It was immediately decided to manufacture a second Globoid drum which would be fitted to the right-hand ranging arm. Prior to the introduction of both Globoid drums trials were first carried out with two cylindrical drums in later years so as to be able to compare them with Globoid

Conduct of trials

The test drums all had the same basic make-up with a diameter of 1800 mm, length of 860 mm, 4 helix turns and the same pick lacing. Drum speed was always 22.5 min-1, rotation direction being selected in such a way that it was always the leading shearer drum which had undershot action.

The comparative drum investigations were conducted during alternate cutting: the shearing run in direction of the main drive, the clearance run in direction of the auxiliary drive. The investigations on both types of drums were as follows:

loading capacity of the drums, establishment
of the average machine speed, product-size
analysis.

The various results were obtained under the following conditions: The loading capacity of the shearer drums was observed visually only. The average machine travel speed was calculated from the operational diagram at the mine control room, on which running time and travel distance of the machine is recorded. As the top road is partly cut by the winning machine the average machine travel speed is lower than the speed on the shearing run. For the product size analysis the same amount of coal was removed at a certain point in the face after machine passage.

Results

The loading capacity of the Globoid drums turned out to be considerably better than that of the cylindrical drums. The better clearing effect of the Globoid drums was particularly noticeable at the T-junction with the top road, where the top road was also being cut. With the cylindrical drums it was necessary to make eight to ten runs into the top road for undercutting and clearing, but with the Globoid drums three to four clearing runs were sufficient to clean the shearing track ahead of the machine frame. With shearing and clearing

Figure 2. Globoid drum in face N-1, Aster seam.

runs generally the shearing track hat also been loaded out much more cleanly after machine passage than with cylindrical drums.

The use of Globoid drums raised the average machine travel time by about 0.85 m/min. The time taken for the clearing run, especially was substantially reduced. The face output was increased by 200 to 300 t/d and the average advance rate stepped up from 3.2 to 4.13 m/d. From this it could also be concluded that the loading behaviour of the Globoid drums is better than that of the cylindrical drums and that the cylindrical drums suffer a performance drop through increased loading effort.

The use of Globoid drums also had a beneficial effect on the size consist of the mined product (Table 2). The size analysis showed that there was a reduction in the proportion of coal fines and ultra fines, signifying a distinct improvement of the size consist. With cylindrical drums the proportion of coal under 1 mm was 16.1 wt. %; with the Globoid drums it was only 9.6 wt. %.

As the preparation costs for ultra fine coal of below 1 mm are roughly 4 DM higher than for those above 1 mm, the exclusive use of Globoid drums with an average production of 6000 t/d disposable would yield a saving of some 400 000 DM/a at Reden colliery.

Table 1. Data on face and face equipment.

Face length	m	206
Seam thickness	m	2,07
Dip in conveying direction	gon	8
Dip in winning direction	gon	8 gon 14
Winning machine		EDW-300 LE
Haulage system		Eicotrack
Shearer drum diameter	mm	1 800
Cutting depth (theoretical)	mm	860
Drum speed	min^{-1}	22,5
Pick lacing		flat round shaft picks, tangential
Number of picks per drum		
on drum	number	66
on backplate	number	32
AFC		PF 2.30
Support		shields

Table 2. Product size consist.

Size mm	Cylindrical drum		Globoid drum	
	wt. %	Σ wt. %	wt. %	Σ wt. %
Over 50	12,5	100,0	22,2	100,0
30 to 50	10,6	87,5	11,5	77,8
20 to 30	13,7	76,9	12,3	66,3
15 to 20	5,5	63,2	5,6	54,0
10 to 15	11,5	57,7	11,0	48,4
8 to 10	1,0	46,2	1,5	37,4
6,3 to 8	3,5	45,2	4,1	35,9
5,0 to 6,3	4,8	41,7	4,7	31,8
3,15 to 5,0	7,2	36,9	6,8	27,1
2,0 to 3,15	6,2	29,7	5,2	20,3
1,0 to 2,0	7,4	23,5	5,5	15,1
0,8 to 1,0	2,1	16,1	1,3	9,6
0,5 to 0,8	3,3	14,0	2,1	8,3
0,315 to 0,5	3,0	10,7	1,8	6,2
0,1 to 0,315	5,2	7,7	2,6	4,4
Under 0,1	2,5	2,5	1,8	1,8