

Leonid N. Orlov, Andriey A. Holyakevych, Igor I. Alekseenko

## Hardening Surfacing with Flux-Cored Wire Increasing the Service Life of Rotating Discs of Defiberiser for Mineral Wool Production

**Abstract:** The article discusses the MAG method-based surfacing of discs of a mineral wool defiberiser performed using self-shielded arc and submerged arc. In addition, the article presents results of tests concerning the service life of discs in relation to the chemical composition of the surfaced layer.

**Keywords:** MAG welding, hardening surfacing, flux-cored wire, service life of materials

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The saving of energy is an important aspect of today's industry and everyday life. One of the methods enabling the saving of energy includes the mineral wool-based insulating of building façades. Mineral wool boards (without the surface cover) are used to insulate roofs, floors and walls. Producers of basalt fibre-based mineral wool are interested in increasing the efficiency of production machinery. The equipment used in the production of mineral wool includes a standard machine (defiberiser) and production line devices. Production line capacity is primarily related to the life of rotating discs. Defiberisers are provided with high-speed rotating discs cooled with water.

Depending on a line type, discs rotate at a rate of 6000 rpm or 9000 rpm. Molten basalt mass having a temperature restricted within the range of 1450°C to 1500°C is fed from the furnace by rotating discs. Centrifugal forces are responsible for the formation of thin fibres of mineral insulation. The third and fourth discs

wear out most intensively. In various companies the service life of discs is restricted within the range of 24 hours to 40 hours. Many discs are repaired in the company's repair department. As regards the making of new discs, the tubular semi-finished product is rolled to a required size allowing for the subsequent surfacing of 3 layers. In cases of defiberisers operated at a rotation rate of 6000 rpm, the discs are repaired up to 10 times. In cases of defiberisers operated at a rotation rate of 9000 rpm, the discs are used on a disposable basis and are not subjected to repair. The reduction of disc operation time is connected with the disturbed shaping of fibres (of a given thickness) and spatters of molten mass (indicating a production-related defect). The defiberiser is then stopped automatically because of the disturbed ejection of molten basalt mass by any disc. It should be noted that in relation to the same period of operation, the shape and size of the wear of the disc work surface may vary significantly.

Leonid N. Orlov, PhD (DSc) Eng.; Andrii A. Holyakevych, Eng. – OOO «TM WELTEK», Kiev, Ukraine; Igor I. Alekseenko, Eng., – E.O. Paton Electric Welding Institute of the National Academy of Sciences of Ukraine, Kiev

The OOO «TM Veltek» company monitored the operation of defiberisers. The monitoring revealed that the size and type of wear observed on the work surface of rollers depended on disc cooling conditions, the chemical composition of cooling water, the molten mineral mass and the chemical composition of a layer hardening the work surface of discs. Related tests aimed to identify the effect of the chemical composition of the hardening layer surfaced using flux-cored wire on the wear of the work surface of discs. Depending on the equipment available to repair teams and user requirements, the hardening layer of discs was surfaced using flux-cored wire having a diameter restricted within the range of 2.0 mm to 3.0 mm, shielding gas mixture M21 (82% Ar + 18% CO<sub>2</sub>) and self-shielded arc under flux AN-26P. The surfacing technology involved the preheating of the disc up to a temperature restricted within the range of 100°C to 150°C followed by the surfacing of three layers using straight polarity DC. The thickness of each run was restricted within the range of 2.0 mm to 2.5 mm. The most commonly used process is submerged arc surfacing performed in a manner allowing for machine cutting, good formation of the surfaced layer, spontaneous separation of slag and the lack of radiation. The welding station was provided with systems enabling the feeding and exhausting of flux, the collection of slag and the exhausting of gases and aerosols. Gas-shielded surfacing processes and submerged arc processes enable the visual inspection of the process.

In cases of the above-named technologies, the welding station is equipped with a shielding gas feeding system, the exhaust of welding aerosols and filters protecting against radiation. The process of surfacing performed using flux-cored wire does not require additional flux or gas mixture. Presently, certain factories in Ukraine and Russia require that the surfacing of discs be performed using flux-cored wires N215-S and N225-S under flux AN-26 and AN-20. The foregoing requirement, conditioned by economic factors, provides good production quality. In view of significant expenses related to repairs and maintenance of mineral wool defiberisers, factories are interested in increasing the service life of discs. To solve the above-named problem, the OOO «TM Veltek» company in conjunction with users performed tests aimed to identify the effect of the chemical composition of a surfaced layer on the wear and service life of discs (Table 1).

The making of new discs or their repair requires the performance of machining enabling the obtainment of a required disc size as well as allowing for the surfacing of 3 layers and the performance of a related mechanical treatment. The time of disc operation is automatically reduced after the recording of disturbances of the fibre-shaping process and spatters of molten mass.

The test results revealed that in cases of surfacing processes performed using wires N215-S and N225-S, the discs were subjected to wear and the lattice of cracks was present in the areas of contact with the molten basalt mass. In

Table 1. Chemical composition (% by weight), hardness and service life of hardening layer

Wire grade	C	Si	Mn	Cr	Ni	Mo	Hardness	Life, h
N215-S	0.06	0.65	5.42	19.2	8.9	-	200 HB	72-90
N225-S	0.05	0.45	0.31	22.5	5.1	2.0	228 HB	56-72
N225.01-S	0.20	1.14	4.04	22.5	-	1.8	217 HB	40-53
N225.03-S	3.12	1.41	0.87	24.1	-	1.1	56-57 HRC	55-65
N225.04-S	0.24	0.70	1.27	27.2	-	-	185 HB	45-52
N225.05-S	1.27	1.03	1.32	27.7	-	-	350 HB	45-57
TMB11CrMnNi	0.10	0.18	13.5	11.0	8.3	-	190 HB	40-65
N225-O2-MnCr	0.08	0.16	20.0	10.7	-	2.0	180 HB	12-30

turn, the use of wire N225-S was accompanied by the increased wear of the disc surface and the formation of the lattice of annealing cracks in the above-named areas (Fig. 1). The most intensive wear could be observed in cases of the disturbed cooling of discs. The structure of the layer surfaced using flux-cored wire N215 was austenitic-ferritic, whereas that subjected to surfacing performed using wire N225 was ferritic-austenitic (Fig. 2).

As regards wire N225.03-S, it was possible to notice the lack of wear location and minimum uniform wear along the entire work surface of the disc. During operation, the surfaced layer of the disc revealed the presence of transverse cracks. The cracks did not penetrate the base material of the disc. The outer face of the disc revealed slight wear without the formation of the lattice of annealing cracks (Fig. 3 and 4).

As regards wire N225.04-S, it was possible to notice the slight location of wear in the central zone of contact with the basalt alloy. The central zone of contact with liquid basalt and the outer face of the disc did not reveal the presence of annealing cracks or the lattice of annealing cracks.

As regards wire N225.05-S, it was possible to observe a significant change in the shape of the wear of the disc surface in



Fig. 1. Surfaces of discs surfaced using N215-S and N225-S after a period of operation

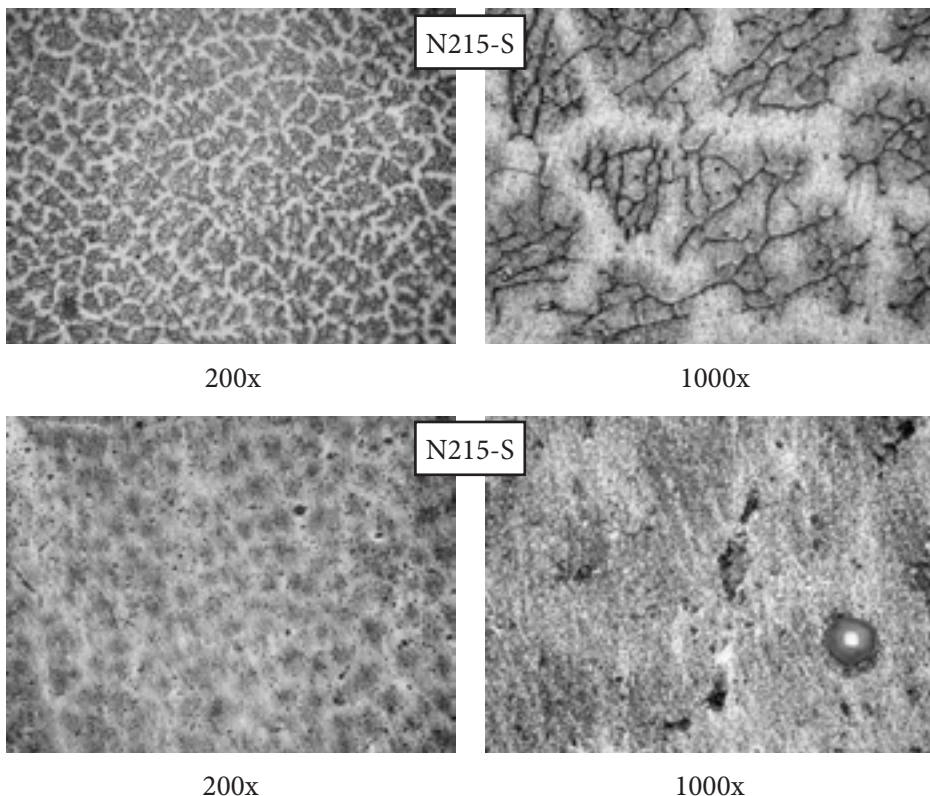


Fig. 2. Microstructure of the layer surfaced using wire N225-S and N215-S



Fig. 3. Disc surfaced using wire N225.04-S after a period of operation



Fig. 4. Disc surfaced using wire N225.05-S after a period of operation

the zone of contact with the liquid. The outer face of the disc revealed narrow and deep wear, whereas along the edge of the zone of contact with the basalt mass it was possible to notice a change in the shape of wear. The surfaced layer did not reveal the presence of transverse cracks.

### Concluding remarks

1. The test results obtained at the first stage of research enabled the identification of the effect of the chemical composition of the surfaced layer on the shape and the location of hardening layer wear.

2. An increase in the hardness of the surfaced layer lowered the location of wear and increased the likelihood of crack formation.

3. An increase in the content of manganese increased the susceptibility to wear location and service life reduction. A nickel addition decreased the susceptibility to wear location.

4. The highest effect on wear was ascribed to chromium and nickel contents.

5. It is believed the research should be continued to identify the effect of alloying agents in the hardening layer on the wear of the layer as well as on the disturbance of the shaping of mineral insulation fibres.