EXPERIENCE IN CLADDING OF PARTS AND UNITS OF CONSTRUCTION AND ROAD-BUILDING MACHINERY

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Described is the experience gained in development of technologies and procedures for repair arc cladding of fast-wearing parts and units of various construction and road-building machines and mechanisms (rotary supports of cranes, drive sprockets of caterpillar machines, support and stretch road rollers, caterpillar tracks, etc.). Consumables developed for cladding make it possible to effectively repair parts and units of the construction and road-building machinery by extending their overhaul life. Flux-cored wire PP-AN202 was developed to weld parts and units made from high-carbon hard-to-weld steels. This wire allows repairing them without or with minimal preheating, thus considerably reducing the power consumption in repair operations. The metal deposited with flux-cored wires PP-AN194, PP-AN198 and PP-AN199 features high operating properties. High wear resistance in metal to metal friction and abrasive resistance of these consumables provides a 2–3 times increase in extension of service life of fast-wearing road-building machine parts and mechanisms. Industrial verification of the repaired parts confirmed the high efficiency of the developed consumables and technologies. 5 Ref., 7 Figures.

Keywords: *arc cladding, low-alloy and high-carbon steels, fast-wearing parts, construction machinery, welding technology, deposited metal, flux-cored wires, development of technologies*

Many parts or units of construction and road-building machinery are operated under conditions of metal to metal friction with or without an abrasive interlayer. In some cases, wear is accompanied by impact loads, which intensify the wearing process. Such parts are made from medium- or high-carbon unalloyed or low-alloy structural hard-to-weld steels.

The E.O. Paton Electric Welding Institute developed the cladding consumables with high welding-operating properties, as well as the technology and procedure for cladding them. Application of the developed cladding consumables allows extending service life of fast-wearing parts of construction and road-building machinery.

In particular, flux-cored wire PP-AN202 providing the deposited metal with a structure of meta-stable austenite was developed for cladding without or with minimal preheating [1–3]. In contrast to solid wire Np-30Kh10G10, flux-cored wire PP-AN202 contains a decreased amount of carbon and has a modified alloying system. As a result, the metal deposited with this wire had hardness in the as-clad condition at a level of *HRC* 30–35. After cold working, the hardness grew to *HRC* 45–50, and the wear resistance increased. Wire PP-AN202 successfully passed verification in cladding of high-carbon steel tram rails [4].

Also, the technology and procedure were developed for cladding of rotary supports of different-modification hoisting cranes by using wire PP-AN202. The hoisting cranes are equipped with unified rotary supports: OPU-1190 (OPU-2), OPU-1400 (OPU-3), OPU-1450 (OPU-4), OPU-1600 (OPU-5), OPU-2240 (OPU-6), and OPU-2500 (OPU-7). Physically, a rotary support is a heavy-weight (up to 1.5 t) large-size radial-thrust roller bearing consisting of a gear ring, and upper and lower half-cages. Components of the rotary support are made from high-carbon low-alloy steels of the 50Kh and 50KhGM grades (hardness of roll surface — *HRC* 55–60).

Surfaces of the gear ring and upper and lower half-cages, over which the rollers move, are subjected to repeated deformations, this leading to their wear.

The technology and procedure were developed for cladding of components of the rotary support for a unique crane with a carrying capacity of 250 t. This support differs in design from the mass-produced devices (Figure 1).

Visual examination, dye-penetrant and ultrasonic inspection show that the following defects are characteristic of roll surfaces of the gear and connection rings: non-uniform mechanical wear of races, as well as fatigue wear showing up as microcracks and local separations of metal caused by repeated deformation of the same volumes of metal (Figure 2).

Prior to cladding, the worn-out surfaces and the rings proper were cleaned from dust, dirt, grease and rust. All the surfaces subject to cladding were tested by the dye-penetrant and ultrasonic methods to check the presence of cracks and other defects. The worn-out surfaces of both rings were machined for cladding by using a boring machine up to complete removal of all defects. Thickness of the removed layer on the rings was not in excess of 5 mm. Repeated dye-penetrant and ultrasonic inspection confirmed the absence of the defects after machining.

Self-shielding flux-cored wire PP-AN202 with a diameter of 2 mm was used for cladding of worn-out rings of the rotary support. The surfaces being repaired were clad in sectors: the length of the arc on the outside diameter was 200–250 mm (approximately 50 sectors). Cladding of the rings was performed simultaneously by two cladding operators (Figure 3) on the diametrically opposite regions of the gear ring. Cladding on the internal surface of the connection and gear rings was performed by one cladding operator also in sectors (the length of the arc was 400–500 mm, following the similar scheme with tilting of the ring using a crane).

Cladding on the horizontal surfaces of the connection and gear rings was performed in two lay-

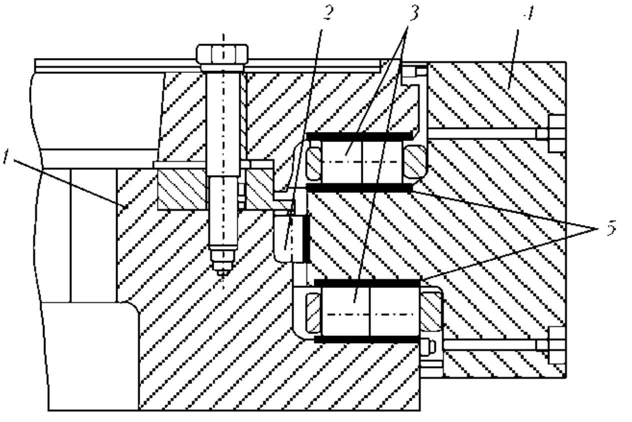

Figure 1. Schematic of rotary support: *1* — gear ring; *2* — vertical rollers; *3* — horizontal rollers; *4* — connection ring; *5* — wear locations

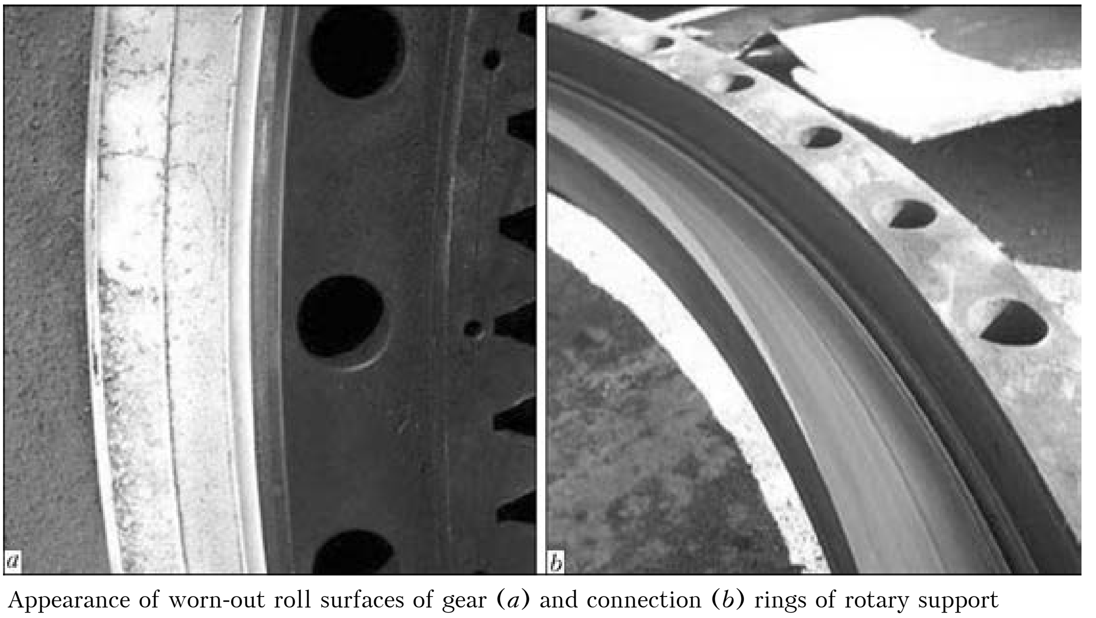

Figure 2. Appearance of worn-out roll surfaces of gear (*a*) and connection (*b*) rings of rotary support

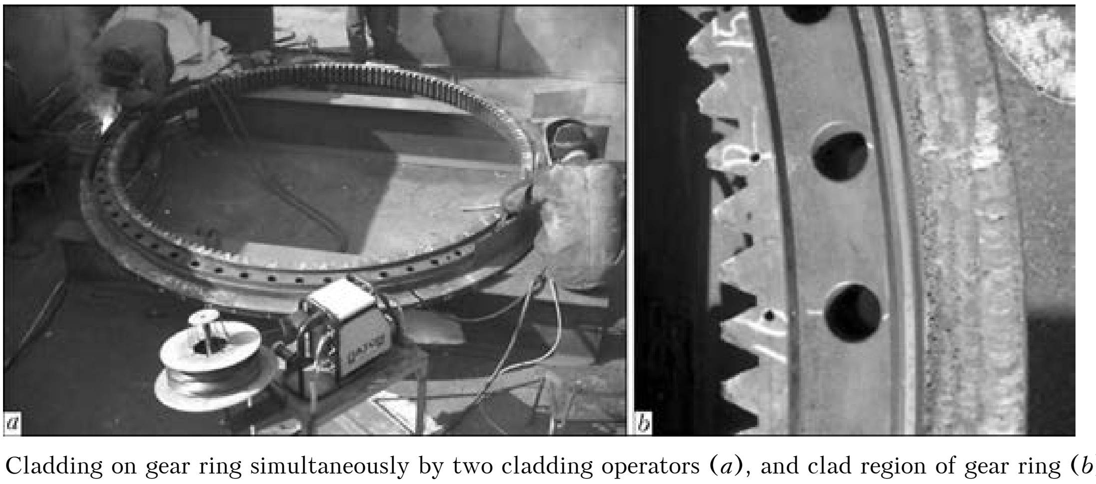

Figure 3. Cladding on gear ring simultaneously by two cladding operators (*a*), and clad region of gear ring (*b*)

Figure 4. Appearance of repaired drive sprocket of crane KS8165

ers, and that on the internal surface of the connection ring — in one layer. Total thickness of the deposited layer was chosen based on the 1.5–3.0 mm allowance for final machining. After cladding, the clad rings were subjected to slow cooling by wrapping them in heat-insulating materials.

No defects were detected in the deposited layer of the clad rotary support rings by dye-penetrant and ultrasonic inspection after machining. Quality of the repaired rings allowed using them in the rotary support of crane MKT-250.

The technology for semiautomatic two-layer cladding using two grades of the self-shielding flux-cored wires (Figure 4) was developed to repair gears of the steel 55 drive sprocket of crane KS8165 with a carrying capacity of 100 t. To prevent cracking, the worn-out surface of a gear was clad using flux-cored wire PP-AN1 providing the ductile sub-layer. Flux-cored wire PP-AN199, which provided the deposited metal with hardness *HRC* 43–52, was used to restore geometry of the gears. Wear resistance of this deposited metal (in metal to metal friction at the presence of abrasive) was more than 2 times as high as that of steel 55.

One of the most fast-wearing parts of caterpillar machines is a caterpillar track. About 80 tracks on the average are used in one caterpillar belt, depending on the model. Special problems arise in repair of tracks of large caterpillar cranes. In particular, the roll surface and studs having the shape of a pyramid with a splayed vertex are subjected to wear in tracks of caterpillar crane RDK-25 made from steel 55. The technology for electroslag cladding with two 0.6×60 mm section strips (steel 65G) was developed to restore studs of the track of caterpillar crane RDK-25. For-

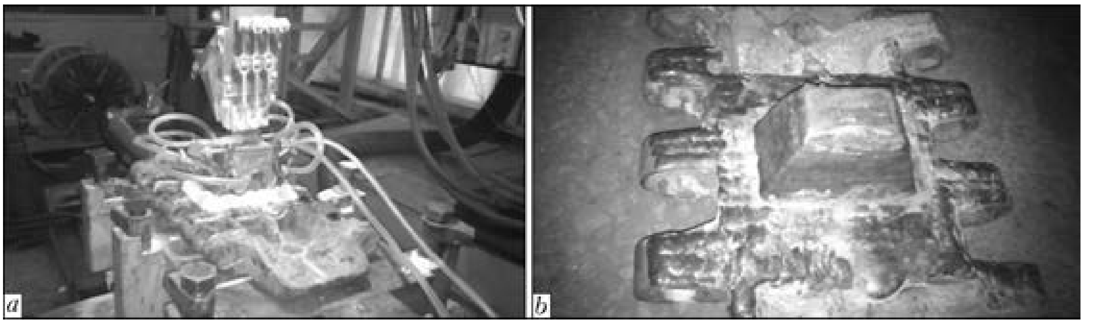

Figure 5. Electroslag cladding of track stud with two strips: *a* — cladding process; *b* — repaired track stud

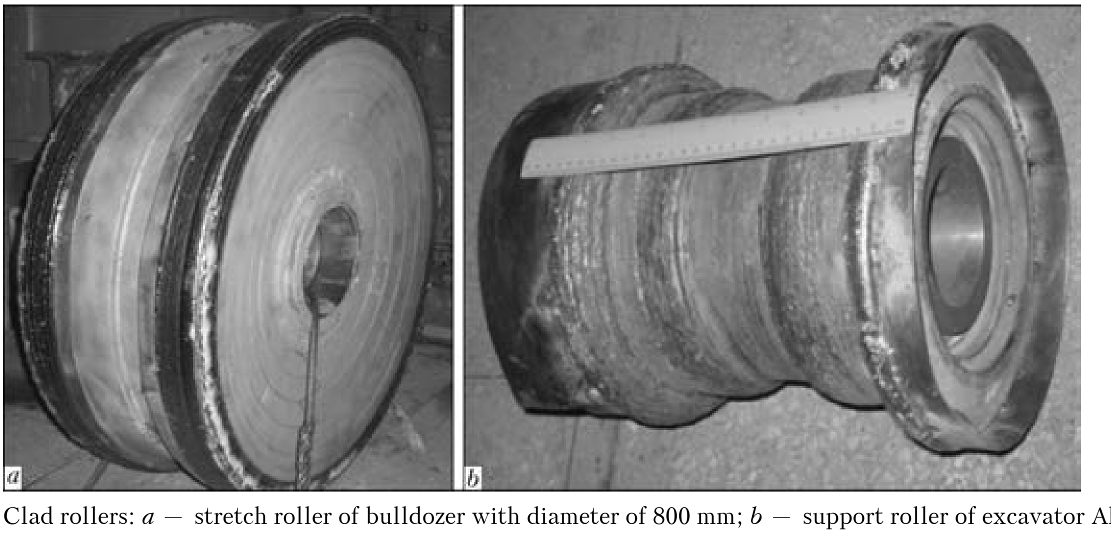

Figure 6. Clad rollers: *a* — stretch roller of bulldozer with diameter of 800 mm; *b* — support roller of excavator Akerman EC450

mation of a stud took place in a copper water-cooled mould (Figure 5). Consumption of the strip for cladding one stud of the track was 4 kg.

Depending on the degree of wear, the roll surface was clad automatically of semiautomatically using the self-shielding flux-cored wire. Here the cost of repair of a track was no more than 30–35 % of the cost of a new track.

Coupled with the caterpillar belt are the stretch and support rolls, which are also subjected to wear. The currently available technologies allow restoring rollers of the caterpillar machines with a diameter of up to 900 mm (Figure 6). The choice of the cladding consumable is based on the roller material. Solid wire Np-30KhGSA and flux-cored wires PP-AN194, PP-AN198 and PP-AN199 are most often applied for cladding of the rollers. Restoration of the imported machine rollers is of a high effect, as the cost of spares for them is very high.

The technology for repair of crane wheels by the arc cladding method is widely applied in industry. Cladding is performed by using solid wire Np-30KhGSA, which provides hardness of the deposited metal equal to *HB* 200–300. For this purpose the E.O. Paton Electric Welding Institute developed sparsely-alloyed flux-cored wire PP-AN194 with phosphorus used as an alloying element, which allowed hardness of the deposited metal to be increased to *HRC* 30–35 [5]. The presence of phosphides in the deposited metal makes it possible to increase wear resistance of the deposited metal more than two times, compared to cladding with wire Np-30KhGSA.

Optimisation of the cladding technology using wire PP-AN194 was performed in restoration of large-size wheels 710 mm in diameter, which are installed on sliding gates of aircraft hangars. Four driving wheels and four driven wheels for such gates were restored for Company «Antonov» (Figure 7). The two-year's operation of the restored wheels confirmed the high wear resistance of the deposited metal.

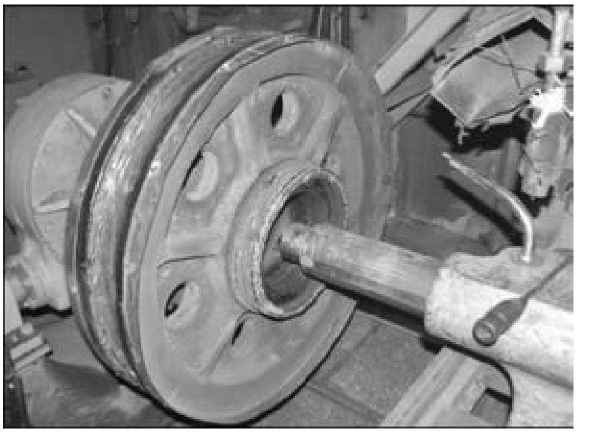

Figure 7. Repaired wheel of sliding hangar gates

As proved by the industrial experience, the developed arc cladding technologies and consumables allow the construction and road-building machinery parts and units to be repaired with a high efficiency.

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