

Contents

1. Renovation of Components	1
1.1. Production of steel in continuous casting lines	2
1.1.1. Relationship between technology and degradation of CBCM rollers.....	4
1.2. Hot-rolling mill	6
1.3. Cold-rolling mill.....	8
2. Selected Components under Extreme Stress and Strain in Metallurgy	14
2.1. Rollers for continuous casting of steel	14
3. The Materials Used for the Production of Rollers for the Continuous Casting of Steel	18
3.1 The effect of heat treatment on metallurgical processes in rollers materials	22
3.2. Analysis of welding properties of rollers materials	22
3.3. Heat treatment of welded joints, CrMo, CrMoV and Cr, CrNi stainless steels.....	24
4. Degradation Factors Affecting the Service Life of Rollers	26
5. Renovation Technologies Used in the Reconstruction of the Continuous Casting Rollers	39
5.1. Submerged arc welding (SAW) methods.....	40
5.1.1. The effect of the welding head position on the quality of weld deposit.....	41
5.1.2. Overlap and mixing of the weld metal	43
5.2. Hard surfacing by means of consumable electrode in protective atmospheres ..	44
of gases (GMAW, FCAW)	44
5.2.1. Shielding gases used in hard Surfacing (GMAW).....	45
5.2.2. Metal Transfer in the Arc (GMAW)	46
5.3. Gas tungsten arc welding (GTAW).....	48
5.4. Manual metal arc welding (MMAW)	49

5.5. Electroslag welding	49
5.6. Electrospark hardening	50
5.7. Laser surface coating of rollers	52
5.8. Bimetallic rollers with centrifugally cast bandage	55
5.9. Filler metals for SAW and GMAW welding (FCAW)	56
5.10. The classification of filler metals used for hard surfacing	58
6. The Selection of Filler Metals Used for Hard Surfacing of Continuous Casting Rollers ..	68
7. Technological Processes in the Rollers Renovation	79
8. Re-Contouring of Hardfacing Overlays	88
8.1. State of the art	88
8.2. Workpiece materials for hardfacings	91
8.3. Cutting tools applicable in turning hard overlays	94
8.3.1. Tool geometry	94
8.3.2. Tool materials and cutting conditions	97
8.3.3. Cutting edge geometry	100
8.4. Machinability of hardfacing layers	102
8.4.1. Tool wear	102
8.4.2. Chip formation and its types	104
8.4.3. Surface integrity	106
8.4.4. Cutting force and temperature	109
8.5. Cooling methods suitable for machining of hardfacing materials	110
9. Surface and its Evaluation in Terms of Microgeometry	116
9.1. Surface micro-geometry	117
9.1.1. 2D evaluation of surfaces micro-geometry	119
9.1.2. 3D evaluation of the surfaces micro-geometry	122
9.2. Devices for surface micro-geometry measurement	128

10. Evaluation of Quality of Renovation Layers.....	134
10.1. Non-destructive testing of weld deposits	134
10.1.1. Visual testing of rollers after hard surfacing	134
10.1.2. Liquid penetrant testing of rollers after hard facing.....	135
10.1.3. Ultrasonic testing of rollers	136
10.2. Destructive testing of weld deposits	142
10.2.1. Visual testing of rollers after hard surfacing.....	142
10.2.2 The evaluation of weld deposit hardness	144
10.2.3 The evaluation of erosive wear resistance of weld deposits	145
10.2.4 Pin-on-disc adhesive wear testing of weld deposits	147
10.2.5 The evaluation of the quality of weld deposits in the conditions of thermal cyclic loading	149
10.2.6 Laboratory methods for assessment of temperature fields and thermal fatigue damage.....	152
 11. Possibilities of Renovation of Machine Parts Using Thermal Spraying Technology ..	163
11.1. Thermal spraying technology	163
11.1.1 Surface pre-treatment prior to thermal spraying	164
11.1.2. Thermal spraying methods.....	164
11.2. Additives for thermal spraying	168
11.3. Properties of thermal sprayed coatings	171
11.4. Coatings applied by the technology of plasma spraying	175
11.4.1. Coatings based on ceramics and composite ceramics.....	175
11.4.2. Cermet-based coatings.....	186
11.5. Coatings applied by the HVOF technology	193