



## Electroslag refining with liquid metal for composite rotor manufacturing

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### ABSTRACT

**Purpose:** To develop novel ESR based process for composite ingot with shallow transition zone between layers in order to produce efficient heavy-weight rotors for steam turbines.

**Design/methodology/approach:** The nowadays heavy-weight rotors for steam turbines for power plants are monoblock or two or more layer in length composite part facilitating operation in different zones withstanding various loads and working medium. However, the joining of various steel in composite rotors by welding has low productivity. The ESR now is recognised as the best available technology for the big-diameter and mass forgings for power generating machines, including rotor ones. The ESR affords the most favourable conditions of solidification resulting in homogenous low-segregation ingot with smooth surface and high-quality structure. The step ahead is the ESR for composite.

**Findings:** The two-layer model ingot had produced from steel grades 12Cr13 and 35NiCrMoV12-5 were manufactured using the electroslag process with the liquid metal (ESR LM) in the CSM of 180 mm in diameter with ingot withdrawing. The transition zone in two-layer ingot had have the shallow shape and low depth with the even macrostructure without defects of the same type as both joined steels. The metal of the transition zone fully satisfies standard requirements for properties of both steel grades in the heat treated and as-cast conditions.

**Research limitations/implications:** The ESR LM can provide both the monobloc heavy ingots with uniform structure and composites with low-stress connection between metal layers for heavyweight rotors and other critical products manufacturing.

**Keywords:** ESR LM, Composite ingot, Heavy rotor, Transition zone, Heat treatment, Microstructure, Mechanical properties

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## **Electroslag Refining Proceedings Of A Conference On Electroslag Refining:**

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such as electromagnetically driven flows surface tension and natural convection driven flows multiparticle systems gas bubbles and impinging jets The discussion on flow measurements and introduction to physical modeling are provided in the last chapter This publication is suitable for a one semester graduate level course for metallurgy and chemical engineering students

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