Combined Rolling and Extrusion production of Wire Rod

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Abstract

The Combined Rolling and Extrusion process (CRE) is an energy efficient production method of wire rod. It combines rolling and extrusion of a continuous cast bar into one single process step. Further reduction and calibration occur in only four subsequent rolling sections. The CRE equipment is designed to produce 1xxx, 3xxx, 4xxx, 5xxx, 6xxx and 8xxx series alloys. The work hardening of the 5xxx series alloys determine the design requirements for the rolling torque as well as the extrusion conditions. Process simulation of the alloys AlMg5, 5356 and 5019 were used during the design and engineering of the equipment.

Keywords: Wire Rod, Continuous casting, Combined Rolling and Extrusion process (CRE), Welding wire.

1. Introduction

RUSAL and the Siberian Federal University in Krasnoyarsk share a long history. Many employees in Siberian smelters have been educated there, and both partners are involved in numerous joint research projects.

The CRE process was developed at the University in the Laboratory of Metal Forming. This faculty specializes in pioneering new technologies and processes for press-products from non-ferrous metals and alloys. The purpose of the invention was to find an efficient process for the production of wire rod and small sections, with low CAPEX and OPEX and a small industrial footprint.

RUSAL took the decision a few years ago to industrialize the process and found the SMS Group in Germany to build the first industrial pilot line. The CRE line was commissioned in Casthouse 1 of RUSAL's Irkutsk smelter and is used for production of wire rod as well as experimental trial production.

2. Process Comparison

The standard process used around the world for the production of wire rod is Continuous Casting & Rolling (CCR). In this process, a continuous cast bar is deformed by a sequence of rolling steps, normally 8 to 10, into a standard 9.5 mm diameter wire rod, which is coiled at the end of the line. CCR is characterized by a single flow metal scheme (Figure 1).

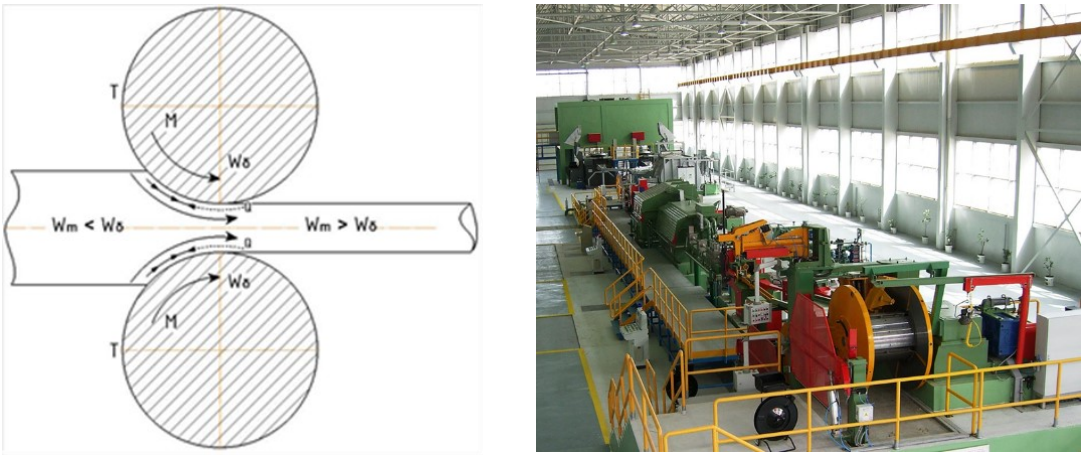

Figure 1. Left: Single flow scheme, Right: CCR line.

The CRE process combines the rolling and extrusion into one single process step. An extrusion die in a die holder is positioned hydraulically directly behind the rolls. The metal flow is a double flow from extrusion in combination with active friction forces from the rolling process (Figure 2). The deformation rates are high and range from 5 to 20.

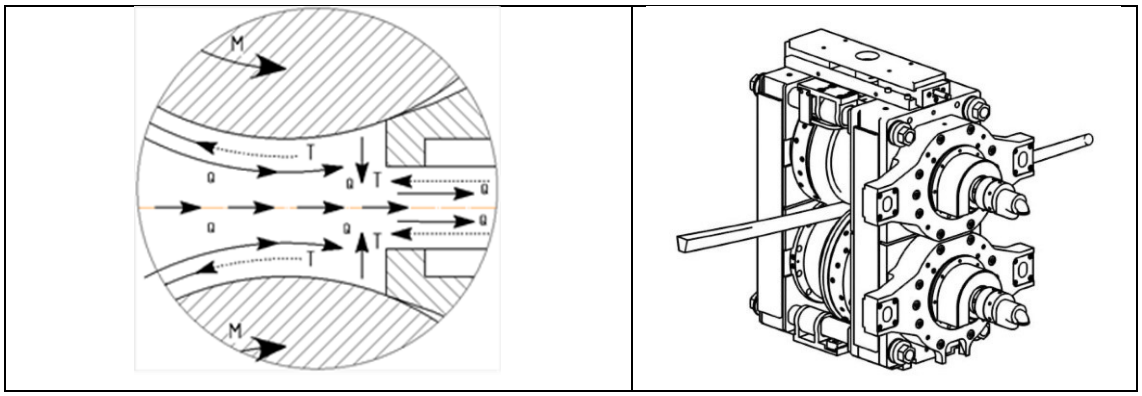

Figure 2. Left: Double flow scheme, Right: CCR line.

A continuous cast bar is rolled / extruded in a single process step to a 16 mm or 18 mm diameter rod. Subsequently only 4 rolling operations reduce the extruded rod to a 9.5 mm diameter wire rod, in two stages of reduction and calibration (Figure 3). CCR lines can produce up to 6 tonnes per hour, whereas the CRE line is limited to 3 t/h.

Figure 3. Reduction and calibration rolls of CRE line.

8. Reference

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