APPLICATION NOTE

Iron, Steel & Metal

Automated positioning and loading of torpedo ladle cars

- Positioning of the car opening under the filling chute, regardless of the car design
- Continuously monitoring the level during the loading operation
- Non-contact measurement is unaffected by high temperatures, flying sparks and dirt

1. Background

In steel production, rather than processing the liquid steel on-site after it is poured, it is often transported to its intended location by way of special rail cars known as torpedo ladle cars. The steel is loaded directly from the blast furnace into the waiting torpedo cars via a chute, which have a capacity of up to 220 t. As soon as one car is full, the train moves forward until the next car is in the correct position.

2. Measurement requirements

A steel producer was looking for a way to automate the filling of torpedo ladle cars. In order to be filled, the opening of each car must be positioned exactly under the chute. Due to the different designs and lengths of the torpedo ladle cars, it is not possible to position them using light beams. Optical systems were tested but due to the heavily dust-laden atmosphere, they were not sufficiently precise. To prevent the cars from being overfilled, the level of the liquid steel (temperature approx. 1700-1800°C) in the torpedo ladle car must be measured during the filling process.

Different types of torpedo cars

KROHNE

3. KROHNE solution

A non-contact radar level meter, the OPTIWAVE 7300, is used to measure the level during loading. The device is positioned above the filling chute and measures down through the chute into the car opening. The distance to the liquid steel is approx. 5 m so no insulation was necessary. Based on empirical data, a single maximum level value was specified for the different types of cars and then programmed into the device.

A second level meter installed at the same place helps position the torpedo ladle cars. Continuous sampling of the surfaces of the torpedo ladle car moving under the shaft allows the OPTIWAVE 7300 to detect the opening. Test measurements showed that the standard measuring interval of 800 ms was not fast enough to send the stop signal. For this reason, KROHNE supplied a custom-built device set at a measuring interval of 250 ms. The OPTIWAVE was designed using 4-wire technology to meet the increased power requirement of the device caused by the higher measuring frequency. Both instruments are equipped with standard DN 80 stainless steel horn antennas.

Right-hand side of picture: Measuring devices at the top of the chute

Filling a torpedo ladle car

Steel ingress hole on top of a car

4. Customer benefits

Using the two OPTIWAVE measuring devices made it possible to automate both the positioning and filling of the torpedo ladle cars. The customer was extremely satisfied with the reliability of both non-contact measurements. In spite of the special requirements, a standard device was sufficient for the level measurement. The device used for positioning was modified slightly, as mentioned, making it possible to repeatedly and precisely position the car opening below the chute. With further work, this measuring device could also be used to detect the different types of cars.

5. Product used

OPTIWAVE 7300 C

- 2-wire FMCW 24...26 GHz radar
- Optionally available as 4-wire design
- Continuous, non-contact level measurement
- Pre-configured ex-works
- Simple start-up thanks to the installation wizard prompting the user to configure the necessary parameters
- For measuring ranges up to 80 m
- Maintenance-free

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