Wire Rod – Tail end placement

Problem statement:

In Wire Rod Mill (WRM) of steel plant the end product is in coil form. The coil is formed at 550 to 900^{o}C, by a rotating head called laying head and positioned at the end of the mill line. The coil is then transferred by Stelmor conveyor for packaging. The tail end of the coil is misaligned from the rest of the coil (it takes much bigger diameter) heap and could get entangled with the other parts of handling device and might get stuck in the passage. When it gets stuck, it may cause damage to the finished product and may lead to stopping of the production line.
To avoid the above situation, currently, the tail end is manually set right by a person using a long rod while the red hot coils are moving toward the Stelmor conveyor.

Figure 1 Red hot coil being produced

Figure 2 Coil entering vertical Mandrel

Current State:

As shown in the Figure 1, the red hot coil is placed on the intermediate conveyor. The conveyor moves at a speed of approximately **10 cm per sec** and goes in to a cooling zone. After coming out of the cooling zone the coil is fed into a vertical mandrel (Figure 2). The front end of coil is well placed inside the coil diameter by the laying head but the tail end comes out in a haphazard manner. Most of the time, the tail end is outside the coil loop as the conveyor drags the coil. If this is left as it is, it will get entangled while entering in to the vertical mandrel. Therefore the tail end is manually positioned every time.

An operator lifts the tail end and places the tail end inside the formed coil loop (figure 3, 4). After proper placement of the tail end the operator comes out of the work zone with the tool. All these operations are done while the coil is in motion.
There are **two problems** associated with this:

a) It is a manual and inefficient process
b) It is hazardous and not very safe for the operator

Figure 3 Operator aligning the tail end of the coil using a tool

Figure 4 Operator lifting the tail end and aligning

The desired solution should **(with no humans)** first identify the misalignment of the tail end of the coil and then align it to get similar outcome as obtained by the operator manually. A typical solution would have following steps:

1. Locating the tail end of the coil
2. Holding the end of the coil
3. Placing the end of the coil inside the coil loop
4. Retracting from work zone
5. Be ready for the next coil.

All the operation is to be done while **conveyor is moving** and with the work zone of **three meters.** The **time available is 10 secs** for the whole process of identifying and correcting the tail end misalignment.

Proper care on safety and coils laying not getting disrupted to be ensured.

In addition, the solution developed

a) Should be a cost effective, in terms of initial investment and running cost
b) Should not have any manual operation
c) Should be fast enough to synchronize with the conveyor speed of 10 cm per sec.

NOTE: Deadline for Phase I submission and Phase II will be updated soon

Structure:

1) Competition will take place in 2 phases
2) **Phase I**-Submission of detailed theoretical description of the solution. Successful submissions must have the technical specs mentioned.
3) **Phase II**- Selected teams will move to phase II. Here the actual system will be developed. These teams will have an opportunity to visit the shop floor and understand the challenge directly. The final system needs to demonstrate on the shop floor.

The selection criteria are as below (for both Phase I and II)

1. Simplicity of the solution – easy to implement, does not affect the other systems in the shop floor - not having too many sub systems as part of the system – Phase I and II
2. Interview results – candidates from Phase I might be interviewed if the description provided in Phase I is not clear.
3. Rich technical content – the system or device to be used should be clearly explained to the specs needed – Phase II
4. Cost – looking for inexpensive solution – Phase I & II
5. Implementation time – should not take too much time to implement it in the shop floor – Phase II

6. Implementation should be demonstrated live on the shop floor – Phase II

Rules:

1. Challenge is open to Btech, Mtech and PhD students of any discipline.
2. A team can comprise no more than 4 members.
3. A team can have no more than one mentor or advisor.
4. Each team needs to nominate a point-of-contact member.
5. Each team needs to submit a proposal in the Phase I
6. Mentor(s) from Tata will be available to guide selected teams during the competition.