THE TECHNOCRACY
STUDENTS' TECHNICAL COMMITTEE, NIT RAIPUR

AAVARTAN'22-23

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DEPARTMENT OF METALLURGICAL AND MATERIALS ENGINEERING

PROBLEM STATEMENTS

MME01. Measuring Shiny Appearance (Gloss) of Steel Wires

Galvanization is the process of applying a protective zinc coating to steel, to prevent rusting. The most common method of galvanization is hot-dip galvanizing, in which the wires are submerged in a bath of molten hot zinc. They have a continuous hot-dip galvanization setup for producing galvanized (GI) wires, which also imparts a glossy appearance to them. 'Extent of gloss or shiny appearance' is one of the parameters used to make a perceptible difference in the quality of GI wires.
We want a solution that will help quantify the 'glossy/shiny appearance' of the wire bundle so as to compare it with another bundle, which may or may not be lying next to it. The solution may quantify (or at least rank) the 'glossy/shiny appearance' of various bundles, which may be lying in different light/ambient conditions. Wire size in the bundle may vary from 0.9 mm to 6 mm. The dimension of a typical bundle (diameter X Height) is ~3 ft. * 4 ft. They are not looking for a solution to determine the 'glossy/shiny appearance' of a specific point on the wire.

MME02. Measurement of coating thickness of Galvanized Iron (GI) wires

Galvanization or galvanizing is the process of applying a protective coating to steel or iron, to prevent rusting. The most common method of galvanization is hot-dip galvanizing, in which the parts are submerged in a bath of molten hot zinc. We have a continuous hot-dip galvanization setup

for producing galvanized iron (GI) wires. The wire diameters range from 1.4 - 5 mm and corresponding zinc coating range from 50 - 300 gsm i.e. 7 to 50 microns.
It is sometimes observed that there is a variation of zinc coating across the length of wire. Currently, we undertake offline zinc coating tests (volumetric zinc coating as per IS 6745) from test samples. This is a reactive mode of determining the coating thickness and does not give continuous feedback to the operators. Any necessary corrective action is thus delayed.
Hence, they are looking for a portable zinc coating measurement system which will quickly provide the coating thickness (online or portable offline) and help the operator to correct the process parameters, without having to cut the test samples & wait for results.

MME03. <u>Automatic Chemical Weighing And Feeding</u>

Leather hides are imparted different colours based on customer requirements. This colour has a standard formula of making, with definite proportion of various chemicals mixed in sequence. These chemicals are in liquid form, having different viscosities. The chemicals are mixed together in a rotating drum to form a colour which is then sprayed on the leather hides using a spray gun. Each leather hide requires 5- 6 layers of different chemical mixes coated using spray gun at different intervals, each coat having different formula and proportion. Currently in this process, the operator collects the chemicals from the store room, weighs and feeds them into the rotating drum as per the recipe, defined in the SAP system.
This whole task of collecting, weighing and feeding the chemicals to the rotating drum is done manually. Therefore, it is quite inefficient and prone to errors. The operator may either miss out a chemical or use incorrect quantities of the chemical or may not follow a specific order. All this can lead to incorrect colour being imparted to the leather, which will not be known until the first batch of leather hide is coloured. Therefore, they need an automated process of colour making.

MME04. <u>Avoiding iron-ore to freeze in bins in sub-zero temperatures</u>

Tata Industries mine and process high-grade iron ore from their hematite deposits in various parts of the world. Fines and superfine material from their beneficiation plant are produced with minimum 64% Fe while their DSO (Direct Shipping Ore) facilities crush, screen and dry 60%-62% Fe iron ore for direct shipping.
The ambient temperature reaches -10 to -40°C in winter and the low temperatures cause problems such as iron ore freezing and choking, thereby reducing the productivity. Iron ore processing plant follows the process steps as below –

a. Mine truck feeds hopper from blended iron ore stockpile
b. From hopper iron ore goes to primary sizer which reduces the size to 100 - 250mm.
c. It is then sent for secondary crushing which reduces to 75 mm
d. It is then sent to Surge bin through 36” wide conveyor belt. These bins have 1000 tons capacity.

e. After Surge bin, ore is sent to drum srubber through apron feeder where water is mixed in ore for further process of screening.

We are facing the problem in Surge bin. In winter season, ore starts freezing and bridging in Surge bin which chokes it and further processing cannot be done. Bridging is a no-flow condition in which material forms a stable arch (bridge, dome) in surge bin due to which ore flow is choked for downstream process.

We are seeking solutions to avoid freezing and bridging of iron ore in Surge bin when ambient temperature drops to -20 to -40°C.

MME05. Corrosion Processes Influence on the Delayed Fracture of the Rod Under Creep Conditions

The relevance of choosing an adequate version of the problem statement on the influence of corrosion processes on ensuring the safe operation of materials and structural elements is beyond doubt. Problem statement options for the delayered fracture of a rod stretched under creep conditions are considered. Two problem statement options are suggested: Taking into account the multistage propagation of the diffusion corrosion process throughout the entire thickness of the rod and taking into account the conjugation of the solution at the boundary of the corrosion layer. To solve the problem, the mechanical and the mathematical model has to be developed, including the modified diffusion equation, the kinetic equation for damage accumulation, and the relation for the chemical interaction parameter. The parameters of this model are to determined based on the experimental dependence of the corrosion film thickness on time.

MME06. Novel refining of High Carbon Ferroalloy by physical or chemical processes

High carbon ferroalloys like ferrochrome or ferromanganese contain about 7-8 wt % carbon dissolved in the form of carbide of Fe, Mn and Si. The heavy requirement of low and medium carbon ferroalloys requirement for steel industries and the increasing sustainability norms enforcing requirement for finding new ways to refine/ segregate these high carbon fractions by applying novel physical or chemical processes. Primary challenge of this concept is to design a process/ unit which will be able to refine/segregate these alloys to get desired low or medium carbon alloys from high carbon ferroalloys.

MME07. Non-destructive evaluation of defects in concrete using surface inspection

It is essential to find defects early in the manufacturing process to avoid waste and deliver high quality products. Increasing demands are being placed on manufacturers to boost efficiency and improve quality for defect-free product. Oftentimes during the formation of concrete, some inevitable defects are formed inside it in the form of internal stresses, residual stresses,

delamination, porosity, blisters and efflorescence. Destroying it, for the purpose of inspection is not always feasible. Thus, demonstrate various non-destructive techniques for the detection and evaluation of such defects in concrete using either a single or a combination of two or more techniques.

MME08. <u>Nitriding without gas to control nitrogen composition</u>

Gas nitriding is a process that uses ammonia or ammonia–hydrogen mixtures to enhance the mechanical properties such as toughness, ductility, hardness and strength by increasing the nitrogen activity. The gas which is used most widely over here is Ammonia. It easily dissociates into gaseous nitrogen and hydrogen according to the chemical equilibrium. However, nitriding with gas leads to certain issues such as when *Excessive nitrogen diffusion to the processed steel surface occurs*, it creates nitride networks which are most likely to cause surface exfoliation. It also increases surface roughness which can be a critical issue or a parameter while constructing of parts requiring the desired composition of steels. Thus, we would like you to propose a method for nitriding without gas to control the nitrogen composition without altering the chemical composition of steels and without hampering the enhanced mechanical properties.