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DESIGN AND ANALYSIS OF EPOXY COATED FLOW THROUGH PIPE BY CFD

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Abstract - *The versatile characteristic of Epoxy and its diversity made it suitable for different industrial applications from laminated circuit board, electronic component encapsulations, surface coatings, potting, fiber reinforcement and adhesives. However, the pervasive applications in many high performance field limited the epoxy usage, due to their delamination, low impact resistance, inherent brittleness and fracture toughness behaviour. Currently, the modified epoxy resins are extensively used in fabrication of natural fiber-reinforced composites and in making its different industrial products due to their superior mechanical, thermal and electrical properties The epoxy resin coating is applied to the pipe. So, we can improve the life time of pipe properties by analysing this concept done by using CFD.*

Key Words: Thermal analysis, Cast iron pipe, Epoxy resin coating, ANSYS software.

1. INTRODUCTION

External surfaces of pipelines are protected from corrosion by polymeric coatings that have evolved in the industry over the past 60 years, beginning with asphalt and then coal tar coatings, followed by polyethylene, epoxy, and urethane coatings. the pipeline coating represents only about 5% of the total cost, the choice of the most effective coating is a key point to guarantee the life of the installed pipelines. In the last few decades, polymeric materials have been widely used in many industrial applications, especially in pipe coatings. These coatings are primarily used for corrosion resistance but also as a protection against mechanical damage. various polymeric materials are employed for these applications such as polypropylene (PP), ethylene butyl acrylate (EBA), fusion bonded epoxy (FBE), high density polyethylene (HDPE), etc. In fact, it represents a durable, high performance and economical coating suitable for steel protection. However, their use in a variety of aggressive environments such as marine environments, humidity, wide range of temperature, UV exposure can affect their lifetime provoking the deterioration of their physical and mechanical properties.

2. FLUID'S FLOW CONDITIONS

Fluid's flow conditions during the incident. This part is subdivided into two sections. Before the rupture, the flow is considered as a steady state flow. The steady state must be calculated as it affects the post rupture condition of the pipeline as well as the thermal stresses induced due to the temperature difference of the fluid and the seawater. The second part referring to the post rupture is transient flow. Intention of investigating post-rupture flow is to determine the worst case scenario concerning the rupture location, as well as the magnitude of the force applied by the escaping fluid jet from the broken pipe's cross-section after rupture. These parts are linked, and are treated together.

3. MASS CONSERVATION

In relation to fluid flow through the pipeline prior to rupture, the mass conservation law implies that matter cannot be lost or created within a closed system; i.e. mass must be conserved. The concept is that the mass in the control volume can neither be created nor destroyed, thus the mass of the fluid in the pipeline can be estimated. This physically translates into that the mass introduced into the closed system, the pipeline in this case, at the inlet point must be contained within the closed system, with no losses or gains over time. The mathematical representation of the law for a system with mass, m, can be written as where m, based on the relation mass = density x volume, can be represented as: where Furthermore, the continuity equation presented below is developed using the mass conservation law as a basis.

4. BOUNDARY CONDITIONS

S. No.	Properties	Value
1.	Inner diameter	17.32 mm
2.	Outer diameter	19.05 mm
3.	Coating thickness	4 mm

5. THERMALPROPERTIES

1. Thermal conductivity inner (k_1) = 0.136 w/mk

2. Thermal conductivity outer (k_2) = 0.15 to 0.25 w/mk

3. Heat transfer coefficient inner (h_1) = 70 w/m^{2}k

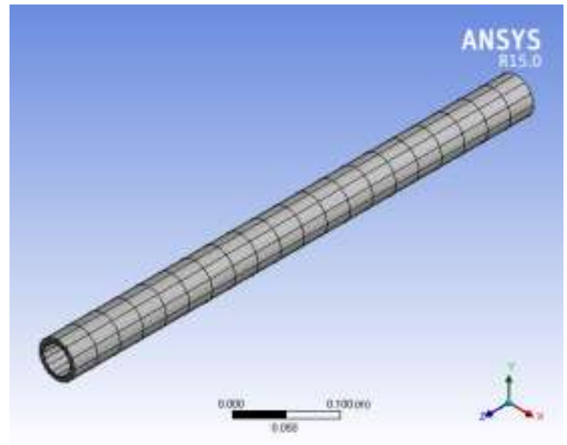
4. Heat transfer coefficient outer (h_2) = 40 w/m^{2}k
5. Temperature inner (T_1) = 90 °C
6. Temperature outer (ambient) = 23 °C
7. Bulk temperature = 70 °C

6. RESULT AND DISCUSSION

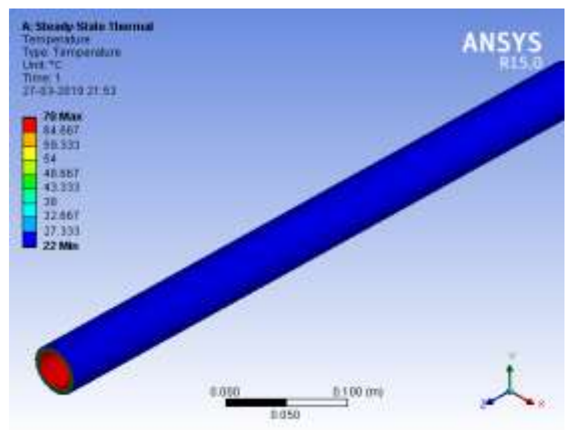
The ANSYS Workbench environment is an intuitive up-front finite element analysis tool that is used in conjunction with CAD systems and/or Design Modeler. ANSYS Workbench is a software environment for performing structural, thermal, and electromagnetic analyses. The class focuses on geometry creation and optimization, attaching existing geometry, setting up the finite element model, solving, and reviewing results. The class will describe how to use the code as well as basic finite element simulation concepts and results interpretation.

6.1 Modelling:

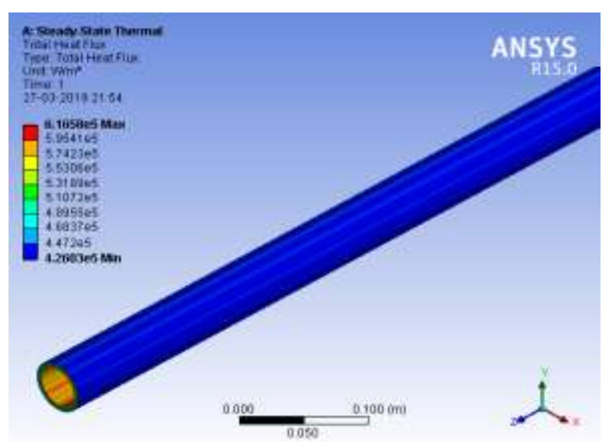
6.2 Meshing:



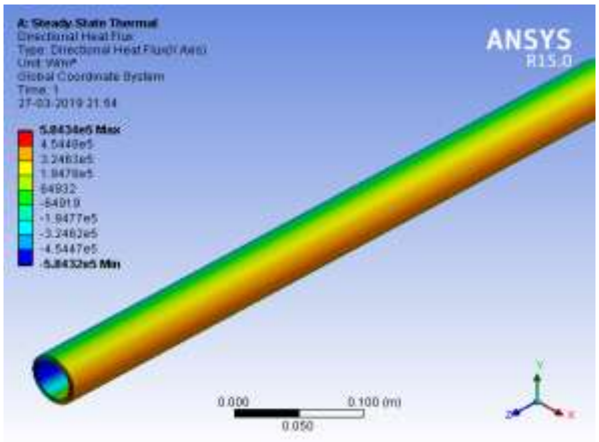
6.3 Temperature (3D view):



6.4 Total heat flux (3D view):



6.5 Directional heat flux (3D view):



7. CONCLUSION

The study shows that the more Coating works as solid material experiences an increase in temperature, the volume of the structure is ultimately impacted by increasing a phenomenon known as thermal expansion. This process, results from heat's ability to increase a material's kinetic energy.

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