Analysis of Flow Ability of Concrete Using Lubricant Admixture Using Discrete Element Method by CFD

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***Abstract* — In our analysis, ANSYS is used and the model is developed on ANSYS 15.0 and also analysed for CFD (Fluent) 15.0. The analysis results show that 6mm of layer thickness of polycarboxylic ether thickness gives absolute convergence on Reynolds stresses, shear stresses and velocity that enhances the flow ability of concrete, Validation and optimization is done to determine the effect of shear stress distribution during flow of concrete inside the steel pipe lubricated with admixture i.e. with polycarboxylic ether. The flow ability of concrete is found to be maximum convergence in 6mm layer thickness of lubricant as compared to 2mm, 4mm and 8mm.**

Keywords— ***Polycarboxylic ether, Reynolds stresses, shear stresses and velocity, steel pipe, concrete, flow ability, Discrete element method.***

I. INTRODUCTION

Concrete is a composite material composed of fine and coarse aggregate bonded together with a fluid cement (cement paste) that hardens (cures) over time. In the beyond limebased cement binders have been often used, which includes lime putty, however every so often with other hydraulic cements, along with a calcium aluminate cement or with Portland cement to shape Portland cement concrete (for its visual resemblance to Portland stone). Many different non- cementations forms of concrete exist with distinctive methods of binding aggregate together, including asphalt concrete with a bitumen binder, which is often used for road surfaces, and polymer concretes that use polymers as a binder. When mixture is blended with dry Portland cement and water, the mixture bureaucracy a fluid slurry this is easily poured and molded into shape. The cement reacts with the water and different elements to shape a difficult matrix that binds the substances collectively into a long lasting stone-like cloth that has many uses. Often, additives (inclusive of pozzolans or wonderful plasticizers) are included within the aggregate to enhance the physical houses of the wet blend or the finished material. Most concrete is poured with reinforcing substances (including rebar) embedded to provide tensile strength, yielding strengthened concrete.

II. Composition

Concrete is a composite material, comprising a matrix of aggregate (commonly a rocky fabric) and a binder (generally Portland cement or asphalt), Which holds the matrix collectively. Many sorts of concrete are available, determined through the formulations of binders and the kinds of mixture used to match the software for the material. These variables determine energy, density, further to chemical and thermal resistance of the finished product. Aggregate consists of massive chunks of material in a concrete aggregate, generally a hard gravel or crushed rocks together with limestone, or granite, collectively with finer materials which incorporates sand. Cement, maximum usually Portland cement, is the maximum popular shape of concrete binder. For cementitious binders, water is blended with the dry powder and mixture, which produces a semi-liquid slurry that can be customary, generally with the resource of pouring it into a shape. The concrete solidifies and hardens via a chemical approach known as hydration. The water reacts with the cement, which bonds the opposite additives together, developing a sturdy stone-like fabric. Other cementitious materials, including ash and slag cement, are now and again added – every pre-blended with the cement or at once as a concrete component – and come to be part of the binder for the aggregate. Admixtures are delivered to alter the therapy rate or houses of the fabric. Mineral admixtures use recycled materials as concrete factors. Conspicuous materials encompass ash, a derivative of coal-fired electricity plant life; ground granulated blast furnace slag, a byproduct of steelmaking; and silica fume, a byproduct of commercial electric arc furnaces. Structures using Portland cement concrete commonly consist of metallic reinforcement. Such concrete may be formulated with excessive compressive electricity, however normally has decrease tensile power. Therefore, it's also reinforced with substances which is probably robust in anxiety, normally metal rebar. Other materials additionally may be used as a concrete binder, the maximum everyday alternative is asphalt, that is used due to the fact the binder in asphalt concrete. The mix format is based totally upon on the type of form being constructed, how the concrete is

 DOI : 10.35291/2454-9150.2020.0658

mixed and brought, and the manner it's miles placed to form the shape.

III. Mix design

Most internal combustion engines are fluid cooled using either air (a gaseous fluid) or a liquid coolant run through a heat exchanger (radiator) cooled by air. Marine engines and some stationary engines have ready access to a large volume of water at a suitable temperature. The water may be used directly to cool the engine, but often has sediment, which can clog coolant passages, or chemicals, such as salt, that can chemically damage the engine. Thus, engine coolant may be run through a heat exchanger that is cooled by the body of water. Most liquid-cooled engines use a mixture of water and chemicals such as antifreeze and rust inhibitors. The industry term for the antifreeze mixture is engine coolant. Some antifreezes use no water at all, instead using a liquid with different properties, such as propylene glycol or a combination of propylene glycol and ethylene glycol. Most "air-cooled" engines use some liquid oil cooling, to maintain acceptable temperatures for both critical engine parts and the oil itself. Most "liquid-cooled" engines use some air cooling, with the intake stroke of air cooling the combustion chamber. An exception is Wankel engines, where some parts of the combustion chamber are never cooled by intake, requiring extra effort for successful operation. There are many demands on a cooling system.

IV. MODELING AND ANALYSIS

Procedure for Solving the Problem

- Create the geometry.
- Meshing of the domain.
- Steady state thermal solver.
- Set the material properties and boundary conditions.
- Obtaining the solution.

Discrete element analysis of flow ability of concrete with layering of polycarboxylic ether on steel pipe.

Type of Element

Tetrahedral

Table : Dimension of steel pipe with Polycarboxylic ether

Diameter of steel pipe	200mm
Length of steel pipe	1000 mm
Thickness of Polycarboxylic ether Layer	2mm, 4mm, 5mm, 6mm

V. RESULT AND DISCUSSION

Table shows the values of shear stress distribution for different thickness of polycarboxylic lubricant on steel pipe.

Shear Stress of Straight Pipe			
Density	**2000**	**2200**	**2300**
2 mm	4000	4250	4330
4 mm	3700	3910	4000
6 mm	3200	3320	3500
8 mm	3500	3700	3820

Velocity of Straight Pipe			
Density	**2000**	**2200**	**2300**
2 mm	9.6	9.1	8.6
4 mm	10.2	9.8	9.2
6 mm	12.4	11.6	10.9
8 mm	11.1	10.7	10.1

Reynolds Stress X - Direction Straight Pipe			
Density	**2000**	**2200**	**2300**
2 mm	3000	3120	3200
4 mm	2800	2980	3140
6 mm	2500	2680	2760
8 mm	2750	2940	3180

Reynolds Stress Y Direction Straight Pipe			
Density	**2000**	**2200**	**2300**
2 mm	9000	9500	9800
4 mm	7500	8100	8600
6 mm	6000	6300	6500
8 mm	7000	7400	7700

Shear Stress of L-Shaped Pipe			
Density	**2000**	**2200**	**2300**
2 mm	3800	3910	4000
4 mm	3640	3720	3810
6 mm	3000	3140	3250
8 mm	3400	3540	3600

 DOI : 10.35291/2454-9150.2020.0658

	Velocity of L-Shaped Pipe		
Density	**2000**	**2200**	**2300**
2 mm	10.3	9.7	9.2
4 mm	11.7	10.3	9.9
6 mm	13.6	12.9	11.1
8 mm	12.4	11.5	10.2

	Reynolds Stress x Direction L-Shaped Pipe		
Density	**2000**	**2200**	**2300**
2 mm	2830	3000	3180
4 mm	2730	2890	2960
6 mm	2210	2450	2680
8 mm	2560	2730	2860

	Reynolds Stress Y Direction L-Shaped Pipe		
Density	**2000**	**2200**	**2300**
2 mm	7500	8100	8900
4 mm	7000	7800	8400
6 mm	5500	5800	6200
8 mm	6000	7000	7400

	Shear Stress of Inclined Pipe		
Density	**2000**	**2200**	**2300**
2 mm	3500	3650	3780
4 mm	3400	3500	3670
6 mm	3050	3240	3350
8 mm	3200	3460	3530

	Velocity of Inclined Pipe		
Density	**2000**	**2200**	**2300**
2 mm	10.8	10.1	9.5
4 mm	12.3	11.7	10.7
6 mm	14.1	13.5	12.8
8 mm	13.6	12.9	11.3

	Reynolds Stress x Direction Inclined Pipe		
Density	**2000**	**2200**	**2300**
2 mm	2710	2840	2970
4 mm	2680	2760	2810
6 mm	2090	2270	2460
8 mm	2430	2580	2750

	Reynolds Stress Y Direction Inclined Pipe		
Density	**2000**	**2200**	**2300**
2 mm	7300	7900	8500
4 mm	6900	7500	8300
6 mm	5000	5300	6000
8 mm	5900	6500	7000

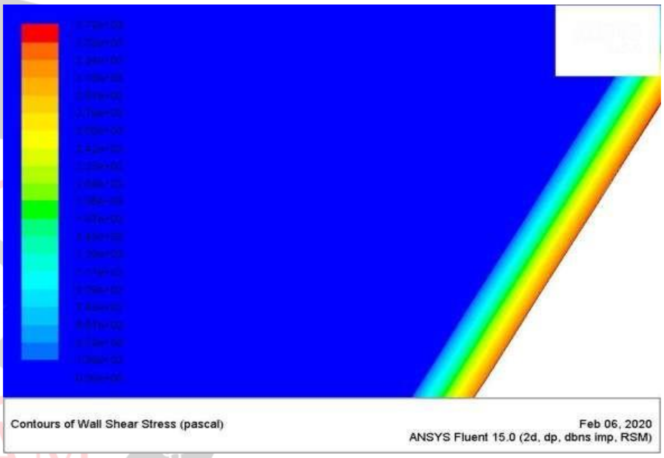
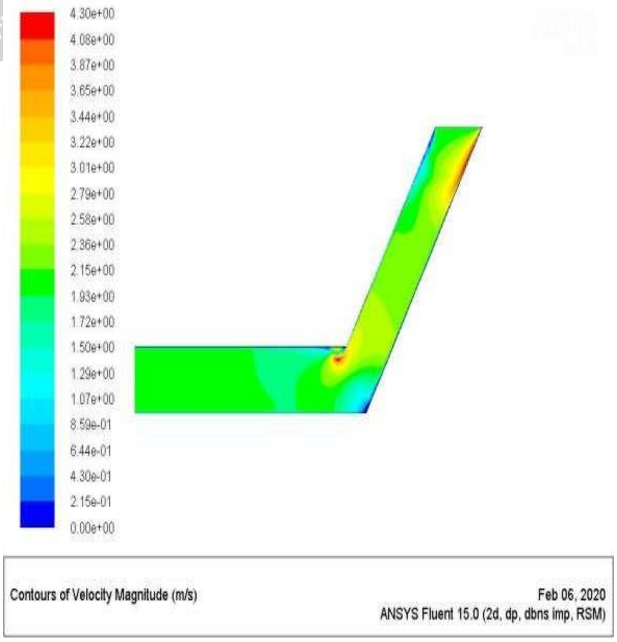


Figure Shear stresses of polycarboxylic ether lubricant layer on steel pipe inclined shaped.



velocity of concrete flow ability of inclined steel pipe.

 DOI : 10.35291/2454-9150.2020.0658

ISSN : 2454-9150 Vol-06, Issue-07, OCT 2020

VI. CONCLUSION

- Average deviation of result obtained from ANSYS in polycarboxylic ether lubricant on steel pipe with different thickness on flow ability of concrete with different density , for base model the shear stress, velocity, reynolds stresses distribution lies within the range, temperature is deviate 2.76% for simulation model.
- Average deviation of results obtained for different layer thickness from ANSYS in flow ability of concrete is deviated by 12.01 % i.e., shear stresses decreases for 6 mm layer thickness for polycarboxylic ether.
- Average deviation of result obtained for different density on polycarboxylic ether on steel pipe with different layer thickness from ANSYS in velocity is deviated by 8.15% i.e., velocity increases for 6mm layer thickness of polycarboxylic ether material.
- Reynolds stresses decreases for 6mm thickness for different thickness of lubricant and density of concrete on polycarboxylic ether coating on steel pipe, the average variation is analyze by 6.7% and for young"s modulus w.r.t. it is decreased by 18.63%, 24.12%, and 19.35%, 16. 97% respectively for different layer.
- This ANSYS analysis clearly indicates that 6mm of layer thickness of polycarboxylic ether decreases the reynolds stresses, thermal stresses and increases velocity with different thickness of lubricant along steel pipe due to this effect flow ability of concrete in steel pipe of material increases.

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