

Application Polyurethane as Coating in Oil and Gas Pipelines

Amir Samimi¹, Soroush Zarinabadi²

¹Department of Chemical Engineering, Mahshahr Branch, Islamic Azad University, Mahshahr, Iran

²Departments of Engineering, Mahshahr Branch, Islamic Azad University, Mahshahr, Iran
(¹amirsamimi1161@gmail.com, ²dr.zarinabadi@gmail.com)

Abstract- Polyurethane is a thermoses polymer with various applications. Using form this polymer has spread for military applications by Otto Bayer in 1930. In one general look polyurethane is product of Iso Syanate and ploy with each other, So that: Iso + ploy = polyurethane. Spend large cost for application and launching oil and gas transitions, has cleared the necessity protection from them agonist corrosion. In this direction protection coating with specific properties such as high electricity resistance presented to market by various companies that each of them has special advantage and disadvantages. In this research has tried while analysis coatings specifications of gas and oil transitional pipelines, has compared properties and common qualities of them with each other.

Keywords- Polyurethane, Protection Coating, Gas and Oil Transitional Pipeline, Tar Coating.

I. INTRODUCTION

Steel pipelines are common device for transition of natural gas and raw oil all over the world, that with spending large costs perform and unchanging. Often this pipe passed (across) from earth corrosive environment or sea bad, repair and reconstruct. Of them is very expensive and its follow with many problems. According to this, protection from oil and gas pipes line is necessary that the most common. Various coatings for protection from oil and gas transitional pipe line have present. To market, that each of them has special advantage and disadvantage. In this research has tried (attempt), within analysis necessary specification for this coatings, compared the most common properties and specification with each other. Coatings specifications (properties) of oil and gas transition pipe lines. Due to electro chemical nature of corrosion pipes buried in earth or sea beds, and the most important specification of protection coatings. Is high electrical resistance and remain stable this specification during time? In addition to, due to implication sever intensions from soil stress, to buried pipes in them, especially in soil with high absorption ability and alternative weather burial, having high strength adhesion and cohesion and resistance to develop crack for protection coatings, is necessary.

Whereas the existence of various chemical material such as salts, acids, material and many microorganism in soils and

seas, cleared the necessity of chemical resistance of this coatings. The durability of coating during transportation storage and pipe installation mechanical properties (Stoke resistance abrasive Flexible and resistance against penetration of sharp edges of rocks and stones). Thermal resistance, easy repairmen of coating damages during installation and are as necessity specification (qualities) of protection coatings of oil and gas transition pipes. Beside, due to stimulate using from coating and catholic protection, also protection coatings resistance are very important to catholic disbanding.

1.1 All Type of Protection Coatings

According to mention qualities, different types of protection coatings have produce and present for external. Coating of oil and gas transition pipeline, in the following has mention to their main and common groups of them, including for coatings, fusion bonded epoxy coatings and poly olefin coatings.

1.2. Tar Coatings

Tar coatings are the oldest coatings that used in oil and gas transition pipes. Some dominant qualities (specification) of them are lack of penetration against water and moisture and high resistance of corrosion, low price and easy operation. While fragility tracked and adhesion drop, in cold weather and flexible in hot weather less mechanical strength, maybe sustain loss or damage during transportation and installation, less resistance against unraveled rays are considered as their disadvantages. Although combined tar coatings with fiberglass or mineral filling material such as silica, has solved solid disadvantages of them, but with become hard environmental regulations and increase acceptance of other coatings, has reduced the amount of tar coatings application. Although has spread using from improved tar coatings with all type of epoxy resin or your than.

1.3. Fusion Bounded Epoxy Coatings

Fusion bonded epoxy coatings are as powder coatings that often apply by electrostatic sprinkle on warm preparing pipes. This coating has good (suitable) mechanical and physical properties and follow with urethane coatings has used on installed pipes on earth surface. Fusion bonded epoxy coatings are naturally hard, fragile and tendency to absorption specific

water in high temperature. Also, most of them has used for installed pipes coating in dry environment.

1.4. Polyolefin Coatings

Poly olefin coatings include polyethylene or poly propylene that has mechanical strength; fairly low pride and high resistance to carrion. The big problems of these coatings are less adhesion of them to steel pipes. For solve the problem has recommended to use three layer coating system including epoxy lining, middle layer, improved copolymer polyolefin and surface coating is polyolefin. In this systems cohesion and resistance to catholic disbanding by epoxy lining and penetration to water and oxygen, mechanical properties and chemical resistance has supply by polyolefin larger.

Epoxy lining by spindle and middle coatings and polyolefin surface coatings has apply on pipes by extrusion methods. Low resistance against penetration sharp edge of stones and rooks especially in high temperature, mad crackup due to soil stress and low thermal resistance, has made some restrictions to using from polyethylene coating.

While high stroke resistance in extensive range of temperature and resistance against penetration of sharp edge of stones and rocks even in temperature more than 100C, has spread largely using from there layer systems on base of polypropylene. Polyurethane is a thermoses polymer with various applications. Using form this polymer has spread for military applications by Otto Bayer in 1930. In one general look polyurethane is product of Iso Syanate and polyol with each other, So that: Iso + polyol = polyurethane.

Term of "100% Solid" Used for Coatings that in them has been any Solvent for dissolve, carrying or reduce amount of coating resins. In addition to, Resins that usually are liquid, after implementation (use) completely change to Solid. Contrary to common coatings Such as epoxies that just limit number of them has been usable for coating, polyurethane coatings have large output from types and shapes; (forms).Tem (Statement) of polyurethane coating is general. Tem, because already contains all things, from wood Seal to building floor and underground tanks coatings.

Nowadays, various type of polyurethane has used in money applications. Flexible polyurethane foams has used for make bed, pillow and car Seat. Hard foams has used for insulation of freezers, refrigerators and roofs. Many Sport Shoes manufactures, has used impact resistance and elastic polyurethane in make shoes surface. In automobile industry, parts such as dashboard and bumper cuttings has mad by polyurethane. In addition to, polyurethane coatings also has used as bridges, seals, surface or tanks lining. Tem "100% Solid" make a little short Range of all kind of polyurethane Bust yet there are hundred different types of Iso Syanate and polyol that by them has produced much polyurethane in this range.

Another factor that could limit polyurethane by it is type of used Iso Syanate in them. The most common isomers that used in polyurethane production are aromatic. Polyurethane that make by aromatics, have economic profit, and doing their work well, But when put against sun light, become as chalky

and dark. Corrosion feature and other physic features of aromatics a system has not affected by sunlight. But if required, are used these coatings in applications that their appearance are important, and cover surface of them should be coatings. Automobile colors named as dominate sample of this type of polyurethane.

II. POLYURETHANE COATINGS PROPERTIES

There are many reasons for tendency to using 100% solid polyurethane coating for pipeline coating.

First of that, using this material has excellent results and this material are famous. Due to harmless, these materials are more adjustment than anti corrosion traditional coatings with environment.

Secondly, due to quick rate of cooking this material, could be put coating pipes under holiday pores test and buried.

Third, this material has ability to cook in low temperature, this subject is impossible in other coatings at last, due to this coatings for application are not need to exothrimicity, and they are applied in any thickness or length and diameter of pipe.

Response nature of Iso Syanate and polyol for polyurethane production is exothermic. Due to this reason, the reaction itself provides needed heat. At last this coatings could be applied in any environment temperature, until apply this coatings unlit 40C' temperature under zero without using extra heat, is not impossible. In spite of properties that mention, 100% solid polyurethane has other good properties, such as:

- 1- Without pothole
- 2- High hardness and impact resistance
- 3- Good flexibility
- 4- Strong adhesion to metal surface
- 5- Be resist against steam penetration
- 6- Separable resistance due to climate factors
- 7- Chemical resistance

The polyurethane coatings can be classification according to type and their additive quantity. But this additives, usually is added to reduce extra price. Also, should be attention additives that reduce price, will be reduce quality. Adding 10 to 20 percent filling material (especially tar) has effective impact on price reduction, but the impact on coating qualities is small. Increase 40 percent or more will reduce price intensively, but will reduce coating properties so much. The common usable filling in 100% solid polyurethane, are tar materials. In this state, usually is use raw oil, asphalt or tar pitch, although should be attention tar pitch is carcinogen.

Table 1: Example from Results of Effectiveness Tests in Some Type of Coatings, Gathering among Various Data of Manufactures

Value	Epoxy	Polyurethane Test
Higher	1/8 Joules	2/3 Jews
Lower	2 mandrill	1 mandrill
Lower	120 milligram pert	52 Milligram pert
Lower	9/7 Cm ²	3/2 Cm ²
Higher	705 N/Cm ²	1410 N/Cm ²
Lower	0/0041 perm. Cm	0/0041 perm. Cm

Recently two additives have added to 100% solid polyurethane coatings. One of them is ceramic powders. These powders have cause coatings with having. The same quantity of elasticity, stroke resistance, has more corrosion resistance. Other additive, are anti – microbial and in washing that cause more protection from coating and under surface from microbiology corrosion. 100% Solid polyurethane has used for internal coatings of cast iron pipes of water and disposal in America since 1988. The purpose from using polyurethane as internal coatings of swedge pipes is prevention from corrosion of internal coatings of pipes and also prevention from microbiology corrosion. The existence of much amount of sulfate in swedge cause to produce H₂S, as result, in state that speed of Swedes movement in pipes are low (level region) , produced sulfuric acid, and due to it , internal coatings pipes destroyed severely. Experience presented that iron case pipes without internal coatings, in this condition has corrode less than 3 years. In analysis has done in Virginia water and swedge research center, samples of cast – iron pipes with 100% solid polyurethane internal coatings has put in Acid sowphric 20% and evaluate internal surface resistance. This analysis has present high resistance of this coating. From 1988 until now, about 610 kilometer from internal coatings of pipes with 12 to 48 inch diameter has used in virginal swage network, and covered by 100% solid polyurethane and this usage has increase process. Covered swedge pipes, has not found any problem during work and operation (application) method of this coatings are very ideal.100% solid polyurethane coating, is non- toxin and has effect on smell or taste of drinking water and is not pollute it.

For this reason, it used widely as internal coatings of water drinking pipes and has cover internal coating of water drinking tanks. With adding antibacterial factors to 100% solid polyurethane could be achieve coating that prevent from bacterial growth in the water. Also with adding special compound to 100% solid polyurethane, achieved coating that has high chemical resistance and used for internal coatings of chemical transaction pipes.

CONCLUSION

100% Solid polyurethane coatings due to suitable properties such as: high adhesion, high resistance to corrosion especially microbial corrosion, suitable flexibility, very good frication and stroke resistance, high chemical resistance and good resistance in high temperature , have various application in external and internal coating of different equipments such as pipes.

In addition to suitable (proper) properties, not be toxin and harmless, more adjustment with environment in comparison with traditional cold coatings , high speed of cooking and in result quick use ability and cooking low temperature of these coatings and lack of need to exothrimicity has cause.

100% Solid polyurethane coatings has account as ideal choice for covering (coating).Has mentioned in thermal cases such as, transitional water tanks, external surface of urban

pipes, internal surface of swedge pipes, internal surface of carrying limy and abrasive solution, mobile concrete coating and upper ground pipes coating. According to very suitable (proper) properties and qualities of 100% Solid polyurethane coatings Could have used these coatings widely in covering to equipments inside the country, for example used in pipeline High electrical, strength and cohesion resistance and also resistance to crack developing such as important specification of suitable coating for external pipes of gas and oil transition pipes and tar, fusion bounded epoxy and polyamine coatings are as the most common coatings that used. In spite of dominate specifications of polypropylenes coatings in comparison with other coatings choose type of coating, number layers and their thickness, are severity under effect of installment environment condition of and oil transition pipes.



Amir Samimi (Corresponding Author)
(16/05/1983, Isfahan City, Isfahan Province, Iran)
M.A Chemical Engineering, Master at Islamic Azad University and PNU, the Member of IAENG, the Member of Young Research Club

REFERENCES

- [1] Nazarboland A, Java poor S. "Application of corrosion technology into gas and oil pipe". Second national conference conference of technology in oil craft, /challenges and strategies
- [2] Moosavi A, Al-Mutawa S, Balboul S, Saad M. Hidden Problems with Three Layer Polypropylene Pipeline Coatings, Abu Dhabi Company for Onshore Oil Operations (ADCO)", P.O. Box 270, Abu Dhabi United Arab Emirates
- [3] External Fusion Bond Epoxy Coating for Steel Pipe/External Polyethylene Coating for Pipe, CAN/CSA-Z245.20/CAN/CSA-Z.245.
- [4] "Pipe Coating Method and Apparatus" Australia/ New Zealand Standard, External extruded high-density polyethylene coating system for pipes, 2002.
- [5] Wong D.T, Holub J.F, Lemenn L, Johnston R.A, "Method of Cooling Coated Pipe", U.S.Patent, Patent Number: 6,270,847.
- [6] Zarinabadi, Soroush, Samimi, Amir, Erfan Ziarifar, Mohammad Sadegh Marouf, Modeling and Simulation for Olefin Production in Amir Kabir Petrochemical, Proceedings of the World Congress on Engineering and Computer Science 2010 Vol II WCECS ,San Francisco, USA,2010.
- [7] Samimi A, Zarinabadi S, Barazandeh A. "Studying water influence into 3 fold polyethylene covers". National conference of chemical engineer, Azad university of Eslamshahr, 2009
- [8] Samimi, Amir, Zarinabadi, Soroush, An Analysis of Polyethylene Coating Corrosion in Oil and Gas Pipelines, Journal of American science,U.S.A.,2011
- [9] Zarinabadi, Soroush, Samimi, Amir, Scrutiny Water Penetration in Three-layer Polyethylene Coverage, Journal of American science, U.S.A., 2011