Scholars Journal of Engineering and Technology (SJET) **ISSN 2321-435X (Online)**
Sch. J. Eng. Tech., 2016; 4(5):258-260 **ISSN 2347-9523 (Print)**

(An International Publisher for Academic and Scientific Resources)
www.saspublisher.com

Review Article

Review of Thermal Insulation Materials for Pipelines

XUE Yihan
School of Petroleum Engineering, Northeast Petroleum University, Daqing 163318, Heilongjiang Province, China

***Corresponding author**
XUE Yihan
Email: lunwen0459@163.com

Abstract: With the decreasing of energy around the world, The significance of energy-saving insulation in industrial and agricultural production and civil life become increasingly prominent. In order to reduce the heat loss of pipeline, and raise the utilization rate of heat energy, a number of scholars have carried out research on thermal insulation materials and their properties. Heat preservation measures must be taken to reduce the heat transfer from the internal heat source to the outside of the pipeline. Obviously, the main purpose is to reduce the heat loss, saving electric energy or fuel. Through the analysis of the current situation of domestic and foreign pipeline insulation, the performance of the main insulation materials were reviewed.
Keywords: pipeline; thermal insulation material; review.

INTRODUCTION

In a dramatic increase in the consumption of the energy, reducing energy consumption has become the urgent problem to be solved. For central heating enterprises, good insulation engineering of heating pipeline, reducing heat loss, and reducing energy consumption, are the important way to improve the economic efficiency of enterprises. Heating pipe usually refers to steam or hot water pipes. Because the medium temperature is higher than the temperature of the air outside the tube, heat will continue to pass through the wall of the heating pipe to the outside air, with heat losing. The purpose of heat preservation is to reduce heat loss caused by heat transfer to the outside of the heating pipeline. A heating enterprise's total length of the heat pipe can reach several hundreds of meters or kilometers, and reasonable choice of heating pipe insulation material has an important significance to reduce heat loss.

INORGANIC FIBER THERMAL INSULATION MATERIAL

Inorganic fiber insulation materials mainly include asbestos, glass wool, aluminum silicate fiber [1]. Asbestos products have the characteristics of light weight, durability, non burning, non corrosion and so on. It is an excellent heat insulation material, at the same time because of asbestos is a very harmful to human health; some developed countries have ceased to use. Glass wool has the advantages of low thermal conductivity, acid resistance, corrosion resistance, low cost, etc, so it is widely used in thermal insulation of buildings and industrial pipes. Although aluminum silicate fiber has a good heat resistance, but the price is more expensive and it is limited to promote the use of it [2].

COMPOSITE SILICATE THERMAL INSULATION MATERIAL

It is a kind of closed porous net structure material which is connected with the solid stroma. Factories mainly adopts the volcano ash glass, jade stone, basalt, sepiolite, bentonite and other mineral materials and a variety of light metallic materials, to make hydrophobic composite silicate insulation materials, by using the principle of the electrostatic method and temperature process [1]. It has low thermal conductivity, high temperature resistance, acid resistance, alkali resistance, salt resistance and oil resistance properties [3].

CALCIUM SILICATE THERMAL INSULATION MATERIAL

It is characterized by low density, high heat resistance, low thermal conductivity, high compressive strength and low shrinkage rate. But in the 90's, the main reason of low application tide is that vendors using the pulp fiber. Because the pulp fiber is not resistant to high temperature, the high temperature resistance is low and the damage rate is increased [4].

HIGH DENSITY POLYURETHANE

In some developed countries it is a more mature advanced technology, for Corrosion protection, good insulation performance and long service life. Due to steel tube surface is very hard to get the outside air and water erosion, its service life is higher than the trench

and overhead laying. Polyurethane insulation material, as a substitute for traditional insulation material, has good energy saving effect. The structure of the heat insulation pipeline is divided into three parts: the steel pipe, the insulation layer, the anti corrosion protection layer. The inner layer is welded steel pipe or seamless steel pipe, and the outer wall is brushed with anti rust and anti-corrosion material or asphalt. The intermediate layer is a heat insulation layer, with low thermal conductivity, low moisture absorption and high strength. The outer layer is a protective layer, which is made of glass fiber reinforced plastics with high strength, corrosion resistance and good waterproof. Composite polyurethane material is the recombination of special-property polyurethane with different types of hollow microspheres. With low density and high compression performance, it is mainly used in the field of deep sea pipeline insulation. Cast in place polyurethane insulation pipeline has easily quality problems [5], there is air inside due to lack of polyurethane foam injection, the density of the insulation pipeline is not up to the standard, polyurethane insulation material is loose, glass fiber reinforced plastic protection layer is broken, interface seal after injection of insulation foam is lax.

POLYPROPYLENE

Polypropylene materials used in the insulation of the submarine pipeline can be divided into three types: solid, foaming and composite [6]. Solid polypropylene thermal insulation material is mainly composed of polypropylene composite material, without any physical strengthening and modification. Polypropylene foam is a component of polypropylene filled with a large number of bubbles by physical or chemical methods [7]. Composite polypropylene is made with hollow glass beads mixed in solid polypropylene composite. Composite multilayer polypropylene has good mechanical properties, low water permeability and ageing-resistant performance, the thickness and the number of layers can be adjusted according to the need, and copolymer adhesive is adopted to improve the bonding between the layers. The structure has the characteristics of heat preservation, light weight, compression resistance, non penetration, stability, good toughness and environment protection, and can be repaired. The technology has been successfully applied in the oil field of Mexico Bay, with the design life of 20 years. At the same time, the production line adopts a highly automated control method, and it is easy for production line to move quickly to build a new plant. It is convenient to set up factories in the place near the construction site.

ETHOXYLINE RESIN

Epoxy resin is a kind of epoxy oligomer, when reacting with curing agent can form a three-dimensional network of thermosetting plastics. Epoxy resin foam plastics can be regarded as a bubble evenly dispersed in the resin matrix of composite materials [6]. At the end of 1940s, the United States shell company first developed. Epoxy foam plastic has the advantages of high compressive strength; short curing time; curing without heating; good heat resistance. The material has a higher modulus of elasticity and excellent resistance to hydrostatic pressure.

PHASE CHANGE MATERIAL

Phase Change Materials can be abbreviated as PCM [8]. In a certain temperature range, phase change energy storage material makes use of itself phase state or structural changes, to automatically absorb or release latent heat from or to the environment so as to achieve the control of the environment temperature. Hallot et al. [9] proposed a new method of thermal insulation based on the use of phase change energy storage materials. In the case of normal pipeline transportation, the heat flux of the crude oil is stored in phase change energy storage material automatically. During shutdown or condensation, phase change energy storage material releases stored heat to the pipeline. The material application requires a lot of theoretical and practical research.

NANO-AEROGEL

Nanometer aerogel (aerogel) is a kind of gel material whose dispersion medium is gas. Nanometer aerogel is nano porous solid materials with network structure made from colloidal particles or polymer molecular, and the size of the pores in the material in nanometer scale. Insulation blankets made from nano aerogel have very good performance [10] : super heat preservation, under the condition of high temperature or low temperature, coefficient of thermal conductivity is the least of all known solid; super temperature resistance, temperature range for a long time is - 80 ~ 650 ℃; super fire resistance, high temperature flame has not any toxic gas and smoke emissions; ultra-thin and ultra-light performance, easy to cut and easy to fold, the construction is convenient; the service life is more than 20 years. Nano aerogel insulation blanket construction technology is not very difficult and can adapt to all kinds of different shapes of pipeline.

CONCLUSION

Oil and gas development has become a hot spot in the world industry and the leading edge of scientific and technological innovation. At present, the technical level of pipeline insulation material development is low, and it is urgent to develop new heat insulation material to meet the needs of oil and gas development. The development of new insulation materials is the main direction, and with the progress of science and technology and the development of new materials technology, excellent thermal insulation materials with new performance are also emerging. It is recommended to select the best thermal insulation material and its thickness by theoretical calculation and numerical

simulation. In the selection of thermal insulation materials, it should be possible to adjust measures to local conditions, and strive to save.

REFERENCES

1. Han Y, Xie H; Analysis of the Selecting of the Insulation Around the Heating Pipes. Refrigeration & Air-Condition, 2006; (4): 60-61.
2. Huang Y; Selection and application for high temperature pipeline insulation materials. Energy for Metallurgical Industry, 2013; (4): 57-60.
3. Sun X; The performance and the application of the composite silicate insulation materials. Cogeneration Power Technology, 2008; (3): 26-27.
4. Song J, Yonghua L, Chen L, Huang H, Yue Z, Mingxia S; Current Research Status and Development of Thermal Insulating Materials in the World. Materials Review, 2010; 4(15): 379-380.
5. Jingping Y, Songjia; Quality control of cast-in-situ polyurethane thermal-insulation pipeline for heat supply network. Heilongjiang Science and Technology Information, 2013; (17):165-166.
6. Jiang Xiao-Bin, Xiang Zheng-Le, Zhang Xiao-ling, DU Bao-yin, Yang Jia-don; Present Situation of Thermal Insulation Material for Deep water Pipeline. Pipeline Technique and Equipment, 2010; (6): 47-50.
7. Yueping L; Molding, properties and application of polypropylene foam plastics. Engineering Plastics Application, 2001; 29(4): 47 -49.
8. Tian Y; Phase change energy storage materials. Chemical Materials for Construction, 2009; 25(4):32 -34.
9. Hallot R, Couprie S, Chomard A; ILS-A Passive Insulation Solution To Answer Cool Down Time Challenges On Deep Water Fowlines. Offshore Technology Conference. Houston, Texas U.S.A., 6-9 May, 2002.
10. Zhang X, Wang Y, Bai Z; Comparison of properties between nano-aerogel and common pipeline insulating materials. Oil & Gas Storage and Transportation, 2015; 34(01): 77-80.