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(54) Title: A COMPOSITE PIPE FOR TRANSPORTING HOT AND COLD WATER

(57) Abstract: A composite pipe comprises a mixture of a polyolefin base resin and a filler. The pipe may comprise a resin mixture of a polyolefin resin, an organoclay and a compatibilizer. The basic material of the composite pipe may be polypropylene random copolymer resin having a melt flow index (ASTM D1238 230°C/2.16kg) of 0.05 to 10 g/10 min. The pipe may comprise a polypropylene random copolymer of 75 to 98.5% by weight, preferably 80 to 98%, an organically modified clay of 0.5 to 10% by weight, preferably 1 to 5% , and a compatibilizer of 1 to 15% by weight, preferably 3 to 10%. The organoclays may be montmorillonite, hectorite and saponite which are organically modified by primary, secondary, tertiary and quaternary alkylammonium or alkylphosphonium cations. Compatibilizers may be maleic anhydride grafted polypropylene (PP-g-MA) or maleic anhydride grafted polyethylene (PE-g-MA).

A COMPOSITE PIPE FOR TRANSPORTING HOT AND COLD WATER

BACKGROUND OF THE INVENTION

The utilization of composite pipes such as plastic-metal pipe, plastic pipe with barrier layer and plastic-glass fiber pipe for heating and drinking water applications has been successful for years.

The most usual forms of composite pipe for transporting hot and cold water are PEX/Aluminium/PEX, PE-RT/Aluminium/PE-RT and PPR/Aluminium/PPR pipes. The essential advantage of the aluminium layer is the reduced thermal expansion as compared with the thermal expansion that is normally attributed to the plastic pipe. The plastic material's thermal expansion is lowered to the level of the metal. Other advantages of the aluminium layer are lower creep characteristics and minimization of wall thickness enabling an increase in the rate of flow for a given outer pipe diameter. A further advantage is the aluminium's being a barrier layer for oxygen gas which could otherwise corrode metal components such as a boiler or a radiator used for a heating system.

A composite pipe with one of the layers being an aluminium alloy does have disadvantages; in particular, the way such a pipe connects with its fittings. For example, PPR/Aluminium/PPR pipes need to be shaved before they are fusion welded with their fittings. If the piping system requires many connections for a particular installation then the shaving gives rise to a lot of work for the installers.

A further disadvantage to the use of aluminium in composite pipe is that the aluminium must be produced. Mining, refining, smelting, alloying and processing are all energy intensive. According to the IAI (International Aluminium Institute) on average, around the world, it takes some 15.7 kW-h of electricity to produce one kilogram of aluminium from alumina. It thus benefits the environment if aluminium is avoided in favor of other materials that impose lesser environmental costs.

PEX/EVOH composite pipes are used for heating systems. Typically, these pipes comprise a thin layer of EVOH resin which has a gas-barrier property, mainly for oxygen gas. A major

drawback frequently encountered with PEX/EVOH pipe is that the thin layer of EVOH (typically 0.05-0.1 mm) may be easily damaged during the transportation of the pipe or during the installation in site, causing the pipe's barrier property to become nonfunctional.

Current global expectations for fuel economy and low emissions for manufacturing and transportation are prompting a search for low cost, high performance lightweight materials. As a filler material, nanocomposites are a class of polymeric materials with superior mechanical and thermal properties. They improve remarkably the properties of materials when compared with virgin polymer. These improvements include increased mechanical strength such as tensile strength, tensile modulus and heat resistance, decreased gas permeability and flammability.

It is thus desirable to provide a composite pipe for transporting hot and cold water. It is likewise desirable to provide a composite pipe which has a low coefficient of thermal expansion. It is also desirable to provide a composite pipe which has a gas barrier property.

SUMMARY OF THE INVENTION

A plastic pipe comprises a polyolefin base resin, such as PE (polyethylene), crosslinked PE, PE-RT, PP (polypropylene) or PB (polybutylene), mixed with an organoclay, such as clays modified by cationic surfactants like organic ammonium salts or alkyl phosphonium, and a compatibilizer, such as maleic anhydride grafted polyolefins like maleic anhydride grafted polypropylene (PP-g-MA).

The homogeneous nanometric dispersion of clay platelets ensures an improvement of the mechanical and thermal properties of the pipe and a decrease of the permeability to oxygen.

Where necessary, the plastic pipe of the present invention further comprises an antioxidant, a processing aid, a coupling agent, a heat or light stabilizer or a pigment, so far as it does not detract from the other goals.

DESCRIPTION OF EXEMPLARY EMBODIMENTS

In an exemplary embodiment, the basic material of the composite pipe is polypropylene random copolymer resin. In an exemplary embodiment, the polypropylene random copolymer resin has a melt flow index (ASTM D1238 – 230°C/2.16kg) of 0.05 to 10 g/10 min.

The exemplary composite pipe comprises a polypropylene random copolymer of 75 to 98.5% by weight, preferably 80 to 98%, an organically modified clay of 0.5 to 10% by weight, preferably 1 to 5% , and a compatibilizer of 1 to 15% by weight, preferably 3 to 10%.

Exemplary organoclays are montmorillonite, hectorite and saponite which are organically modified preferably by primary, secondary, tertiary and quaternary alkylammonium or alkylphosphonium cations.

Exemplary compatibilizers are maleic anhydride grafted polypropylene (PP-g-MA) and maleic anhydride grafted polyethylene (PE-g-MA).

Stated more generally, the material may be a resin mixture of a polyolefin resin, an organoclay and a compatibilizer. The resin mixture may comprise a polyolefin resin content of 75 to 98.5% by weight. The resin mixture may comprise an organoclay content of 0.5 to 10% by weight. It may comprise a compatibilizer content of 1 to 15% by weight. As mentioned above, the polyolefin base resin may be a polypropylene random copolymer. As mentioned above, the polypropylene random copolymer in an exemplary embodiment has a melt flow index (ASTM D1238 – 230°C/2.16kg) of 0.05 to 10 g/10 min.

The resin mixture may further comprise an antioxidant or a processing aid or a coupling agent or a heat or light stabilizer or a pigment in an amount of 0.05 to 5% by weight.

Wall thicknesses. Since the composite particles are nano in size, there are no limitations on the wall thicknesses of the pipe arising out of the composite material itself. The wall thicknesses vary according to national and international standards and the base materials. For example, if the base material of the pipe is polypropylene and the pipes are to be sold in

Europe, then the pipe will be expected to conform to a standard called EN ISO 15874. According to this standard the minimum wall thickness should be 1.8 mm. As a second example, if the base material is crosslinked polyethylene and the pipes are to be sold in the US, then the pipes will be expected to conform to ASTM F876 and 877. According to these standards, a pipe with a diameter of 0.25 inches should have a minimum wall thickness is 0.047 inches.

The thicknesses with the corresponding diameters are stated in the standards. As the pipe diameter increases, the required wall thickness increases.

Fittings. This composite material may be used not only for pipe but for other plastic products also. It can also be applied to all the fittings which are used for joining of the mentioned pipes.

Monolayer or multilayer pipes. In the exemplary embodiment the the pipe is monolayer, disposed as a homogeneous material.

The composite material may, however, be used to produce the pipe in multi-layer form. With this composite pipe all the jointing techniques can be used including fusion welding, electrofusion welding, butt welding, and mechanical ways of jointing such as press fittings, threaded fittings, compression fittings and push-in fittings.

In another embodiment a pipe of the present composite material has an inner or an outer layer (or both an inner layer and an outer layer) comprised of different materials than the present composite material. Such pipe can also be used as a hot and cold water pipe.

In summary, the composite pipe subjected to the invention is produced according to the related standard(s). The chief advantage is it has higher mechanical, thermal and gas-barrier properties compared to the existing pipes produced according to the same standard(s).

Although specific embodiment of the invention has been described to illustrate the principles of the invention, it should be understood that the invention may be embodied otherwise without detracting from the object and the principles of the present invention.

CLAIMS

1. A composite pipe for transporting hot and cold water, wherein the pipe comprising a resin mixture of a polyolefin resin, an organoclay and a compatibilizer.

2. The composite pipe according to claim 1, wherein the resin mixture comprising a polyolefin resin content of 75 to 98.5% by weight.

3. The composite pipe according to claim 1, wherein the resin mixture comprising an organoclay content of 0.5 to 10% by weight.

4. The composite pipe according to claim 1, wherein the resin mixture comprising a compatibilizer content of 1 to 15% by weight.

5. The composite pipe according to claim 1, wherein the polyolefin base resin is polypropylene random copolymer.

6. The composite pipe according to claim 5, wherein the polypropylene random copolymer has a melt flow index (ASTM D1238 – 230°C/2.16kg) of 0.05 to 10 g/10 min.

7. The composite pipe according to claim 1, wherein the organoclay is montmorillonite modified by primary, secondary, tertiary and quaternary alkylammonium or alkylphosphonium cations.

8. The composite pipe according to claim 1, wherein the compatibilizer is maleic anhydride grafted polypropylene.

9. The composite pipe according to claim 4, wherein the compatibilizer is maleic anhydride grafted polypropylene.

10. The composite pipe according to claim 1, wherein the pipe consists of one or more than one layers.

11. The composite pipe according to claim 10, wherein at least one layer comprises a mixture of a polyolefin resin, an organoclay and a compatibilizer.

12. The composite pipe according to claim 1, wherein the resin mixture further comprises an antioxidant or a processing aid or a coupling agent or a heat or light stabilizer or a pigment in an amount of 0.05 to 5% by weight.

13. A composition comprising a resin mixture of a polyolefin resin, an organoclay and a compatibilizer.

14. The composition according to claim 13, wherein the resin mixture comprising a polyolefin resin content of 75 to 98.5% by weight.

15. The composition according to claim 13, wherein the resin mixture comprising an organoclay content of 0.5 to 10% by weight.

16. The composition according to claim 13, wherein the resin mixture comprising a compatibilizer content of 1 to 15% by weight.

17. The composition according to claim 13, wherein the polyolefin base resin is polypropylene random copolymer.

18. The composition according to claim 17, wherein the polypropylene random copolymer has a melt flow index (ASTM D1238 – 230°C/2.16kg) of 0.05 to 10 g/10 min.

19. The composition according to claim 13, wherein the organoclay is montmorillonite modified by primary, secondary, tertiary and quaternary alkylammonium or alkylphosphonium cations.

20. The composition according to claim 13, wherein the compatibilizer is maleic anhydride grafted polypropylene.

21. The composition according to claim 16, wherein the compatibilizer is maleic anhydride grafted polypropylene.

22. The composition according to claim 13, wherein the resin mixture further comprises an antioxidant or a processing aid or a coupling agent or a heat or light stabilizer or a pigment in an amount of 0.05 to 5% by weight.

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INTERNATIONAL SEARCH REPORT

International application No.
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A. CLASSIFICATION OF SUBJECT MATTER

B32B 27/32(2006.01)i, F16L 9/12(2006.01)i, B29D 23/00(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 8 B32B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean Utility models and applications for Utility models since 1975

Japanese Utility models and applications for Utility models since 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKIPASS (KIPO internal)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 05900321 A, (Pelindaba District Brits Atomic Energy Corp. of South Africa Limited.), 04 May 1999 (04.05.1999) see the abstract, column 3: line 56 ~ column 4: line 19, claim 1.	1 - 22
A	JP 13-205760 A, (SEKISUI CHEM CO LTD), 31 July 2001 (31.07.2001) see the abstract, paragraph [0012] ~ [0016], claim 1.	1 - 22
A	JP 08-127101 A, (SEKISUI CHEM CO LTD), 21 May 1996 (21.05.1996) see the abstract, paragraph [0010] ~ [0014], claim 1.	1 - 22

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art

"&" document member of the same patent family

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

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