Patents

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Polymeric composites, oilfield elements comprising same, and methods of using same in oilfield applications

Abstract

Oilfield elements and assemblies are described comprising a polymeric matrix formed into an oilfield element, and a plurality of expanded graphitic nanoflakes and/or nanoplatelets dispersed in the polymeric matrix. Methods of using the oilfield elements and assemblies including same in oilfield operations are also described. This abstract allows a searcher or other reader to quickly ascertain the subject matter of the disclosure. It will not be used to interpret or limit the scope or meaning of the claims. 37 CFR 1.72(b)

Classifications

E21B33/1208 Packers; Plugs characterised by the construction of the sealing or packing means

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Other languages: French

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External links: Espacenet, Global Dossier, CIPO, Discuss

Description

= r Attorney Docket No : 68.0517 POLYMERIC COMPOSITES, OILFIELD ELEMENTS COMPRISING SAME, AND METHODS OF USING SAME IN

OILFIELD APPLICATIONS

Background of the Invention 1. Field of Invention [0001] The present invention relates generally to the field of oilfield exploration, production, and testing, and more specifically to composites of polymeric materials and expanded graphite nanoflakes and/or nanoplatelets useful in such ventures.

2. Related Art [0002] The polymeric materials that are used in oilfield services, and in particular downhole, require good resistance to diffusion/permeation of well fluids (gases and liquids). Unfilled polymers in general have low resistance to diffusion of chemicals that exist in wellbore environments and are more permeable to well fluids. In order to reduce the permeability of polymers, fillers such as carbon black, silica, talc, and the like are added to raw polymers. These fillers have a non-platy structure and/or have low anisotropy (aspect ratio) and therefore offer limited reduction in permeability of the resultant compound.
Expanded/exfoliated graphite nanoflakes and nanoplatelets exist in platelet form, which can have aspect ratio exceeding 100, and preferably exceeding 200.

[0003] United States published patent application 20040127621, published July 1, 2004, discloses methods of making high aspect ratio expanded graphite, and polymer composites made using crushed versions of the high aspect ratio expanded graphite. The reference reports the use of expanded graphite and its products such as nanoflakes and/or nanoplatelets as fillers in polymers. This reference provides methods of expanding/exfoliating graphite and information on surface treatment such as amine grafting, and acrylamide grafting. This reference also provides information on enhancement of mechanical properties and electrical conductivity of the resultant polymer compound. The reference claims the use of the polymeric composites for fuel cells, batteries and catalytic Attorney Docket No : 68.0517 converters. A great number of polymer types are discussed, and the expanded graphite must have length less than 200 micrometers, or less than 200,000 nanometers, and thickness less than 0.1 micrometers, or less than 100 nanometers. While aspect ratio per se is not discussed, from the lengths and thicknesses disclosed, the aspect ratio may be 2000 or greater.

[0004] Nanocomposites are a relatively new class of composites that are particle-filled polymers for which at least one dimension of the dispersed particle is in the nanometer range (10-9 meter). Because of the size of the dispersed particles, certain nanocomposites may exhibit improved mechanical, thermal, optical, and electrical properties as compared to pure polymers or conventional composites. Many references disclose nanocomposites of various polymeric materials and graphite, and discuss one or more properties such as degree of crystallization, electrical and mechanical properties dispersion properties, combustion/flame retardant properties, and the like. Yet other references discuss similar properties of graphene-based composites, including barrier properties.
Graphene is a sheet like structure of hexagonal network of carbon atoms. A carbon nanotube comprises a graphene sheet rounded in a hollow form. Some references report applications of graphene-based composites for radiation and electromagnetic shielding, shrinkage and corrosion resistant coatings. Zhang et al., J. Appl. Polym. Sci., 91:2781 (2004) and references 18-24 listed therein report the use of graphene based polymers for barrier applications. So far as is known to the inventors herein, the use of graphite nanoflakes and/or nanoplatelets having aspect ratio exceeding 200, dispersed in a polymeric matrix or use as barrier materials has not been reported. The use of graphite nanoflakes and/or nanoplatelets in polymers, with the nanoflakes and/or nanoplatelets having aspect ratio exceeding 200 for use in oilfield applications has not been reported.

[0005] Many oilfield elements and tools utilize polymeric materials. For example, electrical submersible pumps (ESPs) are used for artificial lifting of fluid from a well or reservoir. An ESP typically comprises an electrical submersible motor, a seal section (sometimes referred to in the art as a protector) which functions to equalize the pressure between the inside of the system and the outside of the system and also acts as a reservoir for compensating the internal oil expansion from the motor; and a pump having one or more Attorney Docket No : 68.0517 pump stages inside a housing. The protector may be formed of metal, as in a bellows device, or an elastomer, in which case the protector is sometimes referred to as a protector bag.
Elastomers and other polymers may also be used in packer elements, blow out preventer elements, O rings, gaskets, electrical insulators, pressure sealing elements for fluids, and in many other oilfield elements.