Claims

[Claim 1] Fibre-reinforced polyurethane/polyisocyanurate foam block of a thermal insulation body (30) of a sealed and thermally insulating tank, the density of the fibre-reinforced foam block being between 30 and 300 kg/m^3, the fibre-reinforced polyurethane/polyisocyanurate foam block exhibiting a mean density of fibres T_f of between 1% and 60% by weight of fibres (10), preferably between 2% and 30%, and exhibiting a width L of at least ten centimetres, advantageously of between 10 and 500 centimetres, and a thickness E, from the lower face of said block up to its upper face, of at least ten centimetres, advantageously of between 10 and 100 centimetres, the fibre-reinforced polyurethane/polyisocyanurate foam block being composed of cells storing a gas, advantageously having low thermal conductivity,
characterized in that the density of fibres increases along the thickness E, from the lower face of said block up to its upper face (41), from a lower range of density of between 2% and 6% by weight of fibres (10) to an upper range of density of between 12% and 25% by weight of fibres (10).

[Claim 2] Fibre-reinforced polyurethane/polyisocyanurate foam block according to Claim 1, in which the density of the fibre-reinforced foam block is between 50 and 250 kg/m^3, preferably between 90 and 210 kg/m^3.

[Claim 3] Fibre-reinforced polyurethane/polyisocyanurate foam block according to Claim 1 or 2, in which the increase in the density of fibres, with respect to the total weight of the fibre-reinforced polyurethane/polyisocyanurate foam, corresponds to a gradient of increase of between 0.05% and 1.5% by weight of fibres per centimetre, preferably of between 0.2% and 1.2% by weight of fibres per centimetre.

[Claim 4] Fibre-reinforced polyurethane/polyisocyanurate foam block according to any one of the preceding claims, in which at least 60%, preferably at least 80%, of the abovesaid cells storing a gas, advantageously having low thermal conductivity, exhibit a shape elongated or stretched along an axis parallel to the axis of a thickness E of the fibre-reinforced polyurethane/polyisocyanurate foam block.

[Claim 5] Fibre-reinforced polyurethane/polyisocyanurate foam block according to any one of the preceding claims, in which the fibres consist of glass fibre or of hemp fibre, preferably of glass fibre.

[Claim 6] Fibre-reinforced polyurethane/polyisocyanurate foam block according to any one of the preceding claims, in which the fibres are long to continuous fibres.

[Claim 7] Fibre-reinforced polyurethane/polyisocyanurate foam block according to any one of the preceding claims, in which the mean density of fibres T_f is between 2% and 25%, preferably between 4% and 15%.

[Claim 8] Fibre-reinforced polyurethane/polyisocyanurate foam block according to any one of the preceding claims, in which the lower face and/or the upper face (41), preferably the upper face (41), of said block exhibit(s) anchorings (40) capable of engaging with an engaging means of the thermal insulation body (30) in order to anchor the foam block to said body (30), preferably said anchorings (40) being made of a different material from the foam or from the fibres.

[Claim 9] Fibre-reinforced polyurethane/polyisocyanurate foam block according to any one of the preceding claims, comprising a flame retardant in a proportion of between 0.1% and 5% by weight, of the organophosphorus type, advantageously triethyl phosphate (TEP), tris(2-chloroisopropyl) phosphate (TCPP), tris(1,3-dichloroisopropyl) phosphate (TDCP), tris(2-chloroethyl) phosphate or tris(2,3-dibromopropyl) phosphate, or a mixture of these, or of the inorganic flame retardant type, advantageously red phosphorus, expandable graphite, an aluminium oxide hydrate, an antimony trioxide, an arsenic oxide, an ammonium polyphosphate, a calcium sulfate or cyanuric acid derivatives, or a mixture of these.

[Claim 10] Sealed and thermally insulating tank, said tank consisting of:

- a tank integrated in a supporting structure comprising a sealed and thermally insulating tank comprising at least one sealed metal membrane composed of a plurality of metal strakes or metal plates which can comprise corrugations and a thermally insulating body (30) comprising at least one thermally insulating barrier adjacent to said membrane, or
- a tank of type A, B or C according to the definition given by the IGC Code comprising at least one thermally insulating body (30),

characterized in that the thermally insulating body (30) comprises a plurality of fibre-reinforced polyurethane/polyisocyanurate foam blocks according to any one of the preceding claims.

[Claim 11] Ship (70) for the transportation of a cold liquid product, the ship comprising at least one hull (72) and one sealed and thermally insulating tank (71) according to Claim 10, positioned in the hull or mounted on said ship (70) when said tank is of the type A, B or C according to the definition given by the IGC Code.

[Claim 12] Transfer system for a cold liquid product, the system comprising a ship (70) according to the preceding claim, insulated pipes (73, 76, 79, 81) arranged so as to connect the tank (71) installed in the hull of the ship to a floating or onshore storage unit (77) and a pump for driving a flow of cold liquid product through the insulated pipes from or to the floating or onshore storage unit to or from the ship (70).

[Claim 13] Process for loading or unloading a ship (70) according to Claim 11, in which a cold liquid product is conveyed through insulated pipes (73, 76, 79, 81) from or to a floating or onshore storage unit (77) to or from the ship (71).

[Claim 14] Process configured to prepare the fibre-reinforced polyurethane/polyisocyanurate foam block of a thermal insulation body of a sealed and thermally insulating tank according to one of Claims 1 to 9, characterized in that it comprises the stages:

a) of mixing (12) chemical components necessary for obtaining a polyurethane/polyisocyanurate foam, said components comprising reactants for obtaining polyurethane/polyisocyanurate, optionally at least one reaction catalyst, optionally at least one emulsifier, and at least one blowing agent,

b) of impregnation, by gravitational flow of the abovesaid mixture (12) of chemical components, of a plurality of fibre reinforcements (10), said fibre reinforcements being positioned in superimposed layers and exhibiting variable densities, an upper reinforcement layer having a density of fibres at least equal to that of the lower reinforcement layer, in which the fibre reinforcements (10) extend essentially along a direction perpendicular to the direction of said gravitational flow,

c) of formation and of expansion of the fibre-reinforced polyurethane/polyisocyanurate foam,
in which the expansion of the fibre-reinforced polyurethane/polyisocyanurate foam is said to be free, i.e. without the constraint exerted by a volume of closed section, or
in which the expansion of the fibre-reinforced polyurethane/polyisocyanurate foam is physically constrained by walls of a double band laminator, preferably is physically constrained by the walls of a double band laminator forming a tunnel of rectangular section with a distance between the walls positioned laterally equal to L and a distance between the walls positioned horizontally equal to E, thus enclosing the expanding fibre-reinforced foam so as to obtain the abovesaid fibre-reinforced polyurethane/polyisocyanurate foam block.