NOVEL ULTRA–HIGH PERFORMANCE CONCRETE

The present invention relates to the field of materials for the field of construction, and more particularly to a hydraulic composition allowing an ultra–high performance concrete to be obtained.

Technological progress in recent years in the field of concretes has led to the development of ultra–high performance concretes, particularly in terms of compressive strength. These concrete formulations generally involve the recourse to additional materials other than the cement and aggregate e.g. fibers, organic admixtures or so–called ultrafine particles generally of smaller size than the cement particles.

The use of these ultra–high performance concretes is made delicate when the question is to produce in one go concrete parts comprising horizontal elements and vertical or inclined elements. For example when the question is to manufacture in a factory a concrete part, the final section of which is U–shaped or L–shaped, it is necessary to separately and horizontally cast the elements of the part to be produced and then to assemble them by adhesively bonding them, by anchoring or screwing them together in order to obtain the U– or L–section. This has the drawback of multiplying the manufacturing operations for these parts, the manufacturing of the part per se becomes complex, increasing the possibilities of errors and reducing the robustness of the parts.

Also there exists a need relating to ultra–high performance concrete formulations with which concrete parts may be made in a single step, regardless of their shapes or their sections without resorting to an assembling step.

Summary

The problem that the invention sets out to solve is therefore that of providing novel formulations for non–self–levelling, ultra–high performance concretes which are able to remain in place when applied to an inclined or vertical plane.

In one aspect, there is provided a hydraulic composition comprising in relative parts by mass with respect to the cement:

- 100 parts of cement the particles of which have a BET specific surface area comprised from 1.20 to 5 m^2/g;
- 32 to 42 parts of water;
- 5 to 50 parts of a mineral addition A1 the particles of which have a D50 less than or equal to 6 µm and selected from silica fume, metakaolin, slag, pozzolans or mixtures thereof;
- 90 to 230 parts of sand the particles of which have a D50 greater than or equal to 50 µm and a D90 less than or equal to 3 mm;

- 0.0001 to 10 parts of a superplasticizer, the active material concentration of which is 15 % by mass.

In another aspect, there is provided a method for producing a hydraulic composition as disclosed herein wherein the cement, additions, sand, water and superplasticizer are mixed.

In yet another aspect, there is provided an object formed for the field of construction comprising the hydraulic composition as disclosed herein.

In a further aspect, there is provided a method for manufacturing an object for the field of construction comprising the following steps:

(i) preparing a hydraulic composition as disclosed herein;

(ii) applying the composition prepared at step (i) to a support.

In another aspect, there is provided a hydraulic binder comprising the materials of the hydraulic composition as disclosed herein with the exception of:

- water; and
- superplasticizer when it is liquid.

The concrete compositions of the present disclosure have the following advantages:

- they may be applied by projection, in particular with a projection gun or by spraying with a projecting lance;
- they may be used in methods for manufacturing concrete parts by calendering;
- they may be used in repairing or rehabilitating concrete structures existing on inclined or vertical surfaces, for example a pier or bridge slab, or an unloading dock of a harbor;
- they have compressive mechanical strengths at 28 days generally comprised from 90 to 150 MPa, or even more;
- they may contain fibers giving them additional interesting properties, like ductility;

- they have a stress threshold greater than 50 Pa measured at a shear gradient of 0.1 s^{-1}, preferably greater than 100 Pa.

Detailed Disclosure of Embodiments

The present invention relates to a hydraulic composition comprising in relative parts by mass with respect to the cement:

- 100 parts of cement the particles of which have a BET specific surface area comprised from 1.20 to 5 m^2/g;
- 32 to 42 parts of water;
- 5 to 50 parts of a mineral addition A1 the particles of which have a D50 less than or equal to 6 µm and selected from silica fume, metakaolin, slag, pozzolans or mixtures thereof;
- 90 to 230 parts of sand the particles of which have a D50 greater than or equal to 50 µm and a D90 less than or equal to 3 mm;
- 0.0001 to 10 parts of a superplasticizer, the active material concentration of which is 15 % by mass.

In the remaining text, the expression "hydraulic composition of the invention" designates the hydraulic composition described above and its variants No1 and No2 described below.

According to variant No1, the hydraulic composition, in relative parts by mass with respect to the cement, comprises:

- 100 parts of cement the particles of which have a BET specific surface area comprised from 1.20 to 1.7 m^2/g;
- 38 to 42 parts of water;
- 8 to 20 parts of a mineral addition A1 the particles of which have a D50 less than or equal to 6 µm and selected from silica fume, metakaolin, slag, pozzolans or mixtures thereof;
- 90 to 180 parts of sand the particles of which have a D50 comprised from 100 µm to 400 µm and a D90 less than or equal to 800 µm;
- 0.0001 to 10 parts of a superplasticizer, the active material concentration of which is 15 % by mass.

According to variant No2 the hydraulic composition, in relative parts by mass with respect to the cement, comprises:

- 100 parts of cement the particles of which have a BET specific surface area comprised from 1.20 to 5 m^2/g;
- 32 to 42 parts of water;