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NOTE

Interaction of Expanded Polystyrene Beads and Polyamide 66 Yarns with Components of Cement—A New Composite

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In this study, polystyrene beads as lightweight aggregate and mortars containing silica fume as a supplementary cementitious material and polyamide 66 to reduce cracks in concrete were used. The idea of this new composite is being reported for the first time.

Key Words: Composite, Cement, Polystyrene beads, Polyamide 66 yarns.

There are many lightweight composites that contain recycled fillers but a combination of polystyrene and polyamide fibres (PA 66) as a supplementary cementitious material has never been reported elsewhere. However, polymers and organic admixtures interact with the components of cement when coming into contact with water. It should be noted that, if some plastics are added to the raw materials, it is possible to increase the volume of the voids by controlled procedure. By increasing the volume of the empty spaces, the weight of concrete is reduced.

Some researchers reported the use of polystyrene in concrete[1–3] but they could not resolve the problem of cracks propagation. In this paper, a novel method to reduce cracks using polyamide yarns for the first time has been offered. Polystyrene is a vinyl polymer, structurally, it is a long hydrocarbon chain with a phenyl group attached to every other carbon atom. Polystyrene is produced by free radical vinyl polymerization, from the monomer styrene. EPS is comparatively inert and is unaffected by mildly acid or alkaline building materials such as Portland cement, lime or anhydrite. It is, however, soluble in many organic solvents and may be damaged by certain commonly used paints, adhesives, wood preservatives, pasting agents, etc. In some cases, vapour from these substances can be harmful.

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Polystyrene granules supplied by BASF, PA 66 yarn, supplied by Dupont and cement and silica fumes with the following chemical compositions were used in this experiment.

$SiO_2 = 63\%$,	$Al_2O_3 = 5.02\%$,	$Fe_2O_3 = 4.02\%$,
$CaO = 64.47\%$,	$MgO = 3.85\%$,	$SO_3 = 0.73\%$,
$R_2O = 0.75\%$,	Others = 0.33%	$C_3S = 63\%$,
$C_2S = 11\%$,	$C_3A = 7.0\%$,	$C_4AF = 10.5\%$
Cement = 330 kg/m^3,	Silica fumes = 3%	

Procedure

Concrete was mixed in a mixer. Polystyrene and polyamide 66 yarn were wetted initially with a part of a mixing water and super plasticizer before adding the remaining materials. Mixing was continued until a uniform mixture was obtained, and then they are compacted in the moulds.

Contact zone between polystyrene, polyamide 66 and cement

Fig. 1 allows to identify the excellent distribution and the uniformity of mixture obtained. The adhesion strength of composite used is very high.

The compressive strength of the investigated material depends on its density and the type of granules used. The type of EPS used in this study for the first time show the dependence of compressive strength values on density (Table-1).

TABLE-1
THE INFLUENCE OF COMPOSITE DENSITY ON COMPRESSIVE STRENGTH

Density, (kg/m^3)	Compressive strength, (kN/mm^2)
180	0.10
220	0.12
260	0.22
300	0.31
340	0.48

Conclusion

In order to increase the cohesion of polystyrene beads with the binding agents, the size and shape of granules are utmost important. The compressive strength of the created composite material depends on its density and types of granules used. The rate of strength development of the concrete can be improved with increasing percentage of silica fume. The use of polyamide 66 had a significant influence in crack reduction. This combination is being reported for the first time.

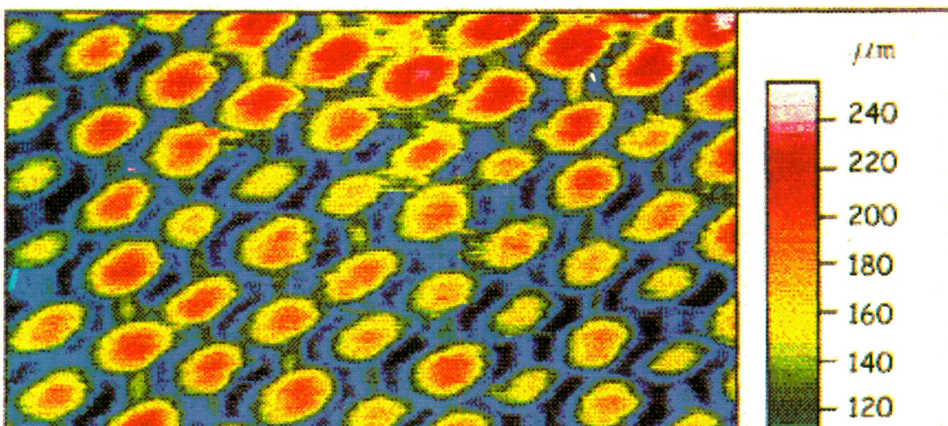

Fig. 1. Contact zones of polystyrene and polyamide 66

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