New polymer admixture improves mechanical concrete properties

What's New

Plastics are used increasingly as admixtures to improve the working and service properties of concrete, and the latest advancement comes from Germany. A new admixture for concrete and mortar touts enhanced mechanical properties and easier handling.

Hans-Josef Laas, Jan Mazanek, Martin Brahm, Hermann Kober, Manfred Schonfelder, Dietbert Knofel, Karl-Georg Bottger, and Anke Reinschmidt received a U.S. patent for "Use of Nonionic, Water-Dispersible Polyisocyanates as Concrete Additives."

Polyisocyanates researched previously are hydrophobic (i.e., they repel or are repelled by water) and cannot be stirred homogeneously into an inorganic binder like cement, even when combined with additional organic compounds. These compounds raise ecological concerns or require special high-speed mixers.

Attempts have been made to use self-dispersible polyisocyanates that are hydrophilically modified (i.e., they attract or are attracted by water) by the incorporation of ionic chemical groups. Although these modified polyisocyanates do not require high-shear mixing, their shelf life is too short because the catalytic activity of ionic groups produces a gel-like material in a few days.

The invention uses isocyanate-functional admixtures composed of water-dispersible polyisocyanates rendered hydrophilic with nonionic groups. These admixtures don't gel in storage, are free of potentially harmful organic solvents, can be easily mixed, and provide excellent dispersion of even the smallest particles.

The admixture appears to improve concrete compressive and tensile strength. The amount of admixture in the mortar was varied by weight under different conditions such as temperature, and the results were tested according to DIN (German Institute for Standardization) procedures. Prisms 40x40x160 mm per DIN EN 196, Part 1, were prepared as test specimens. The test specimens were demolded after hardening, 1 to 3 days after production. The standard prisms were then stored under water at 20° C (68° F) until the 7th day following production, after which they were stored in a controlled climate at 23° C (73° F) and 50% relative humidity until tested.

— Paul Campbell's Web site: http://techpubs.home.netcom.com

Mortar flexural strength and compressive strength after 7 and 28 days hydration

Sample	Admixture	Releasable after (days)	Flexural strength (psi)[a]		Compressive strength (psi)[a]	
			7d	28d	7d	28d
Comparison	—	1	1087 (100%)	1366 (100%)	6950 (100%)	8795 (100%)
1	Z1[b]	3	1493 (137%)	1906 (140%)	11,526 (166%)	14,529 (165%)
2	Z2[b]	3	1384 (127%)	1486 (109%)	8837 (125%)	12,198 (139%)
3	Z3[c]	1	1522 (140%)	2081 (152%)	11,211 (161%)	14,057 (160%)
4	Z4[c]	1	1108 (102%)	1420 (104%)	8823 (127%)	11,697 (133%)

[a] Percentages refer in all cases to the values of the comparison mortar
[b] Samples Z1 and Z2 used the same admixture in different quantities
[c] Samples Z3 and Z4 had different chemical compositions from each other and from Z1 and Z2

Publication #J00D031