POLYPLEX

An All-Acrylic Polymer Curing Agent for GFRC

POLYPLEX is a specially formulated, all-acrylic polymer emulsion, which can be used in GFRC mixes to eliminate the necessity for seven-day wet cure.

ADVANTAGES

Until the introduction of acrylic polymer, GFRC products required a seven-day cure in over 95% humidity in order to ensure full curing of the Portland cement. (This usually meant building curing rooms where the product could be stored in the required wet environment).

- Where manufacturing was done in an enclosed building, the provision of a curing area resulted in the loss of valuable production space. Where manufacturing was essentially performed outside, the provision of a satisfactory curing area was difficult, if not impossible.
- **POLYPLEX** polymer eliminates the need for the wet curing period and the associated costs of curing areas and lost production space. These cost savings more than offset the added cost of incorporating **POLYPLEX** in the mix.
- **POLYPLEX** provides added workability to the GFRC mix, and particularly better adherence to vertical mold surfaces, eliminating sliding of the wet mix. It is suitable for use with both white and gray Portland cements.
- **POLYPLEX** does not yellow when weathered, and so it will not discolor panel finishes, as some acrylic polymers can do.

PRINCIPLES OF THE POLYPLEX POLYMER CURING EFFECT

Because it is thin, compared to conventional concrete (1/2" compared to 3" or thicker), GFRC without polymer can lose water by evaporation too quickly. To maintain sufficient water in the composite to ensure complete hydration of the cement these composites had to be stored in a wet environment.

POLYPLEX when added to GFRC mixes at the recommended levels, does not change the hydration process of Portland cement. Its function is to reduce permeability, first on the surface by forming of sealing film and then within the composite during the first few hours of curing. This reduced permeability in the composite significantly lessens the loss of water by evaporation, facilitating the full hydration and cure of the Portland cement. Excessive loss of water during curing, to such an extent that there is not sufficient water remaining to fully hydrate the Portland cement, will result in low cement and composite strengths. Further, there are no remedial procedures that will retrieve the composite strengths if the initial cure is not done correctly.

POLYPLEX only eliminates the need to keep GFRC products in a moist or wet environment after de-molding. Portland cement still requires storage at or above 55°F, to develop full strength within 28 days. Any temperature drop below 55°F, although not stopping the cure, will slow the hydration reaction so that full cure and strength development will take longer than 28 days.

PHYSICAL PROPERTIES

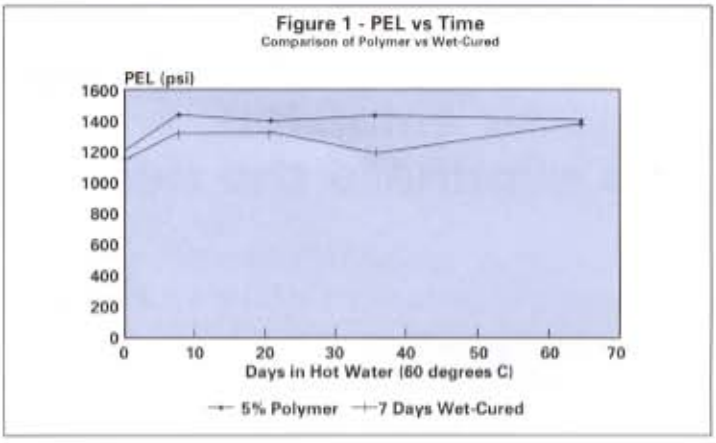
Table 1 shows a comparison between seven day and 28-day physical properties for GFRC containing 5% polymer solids and wet cured GFRC containing no polymer. The tests were done in accordance with ASTM-C947-03.

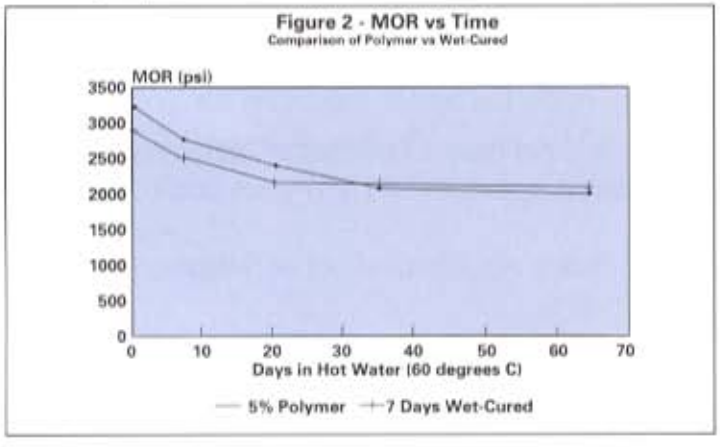
TABLE 1

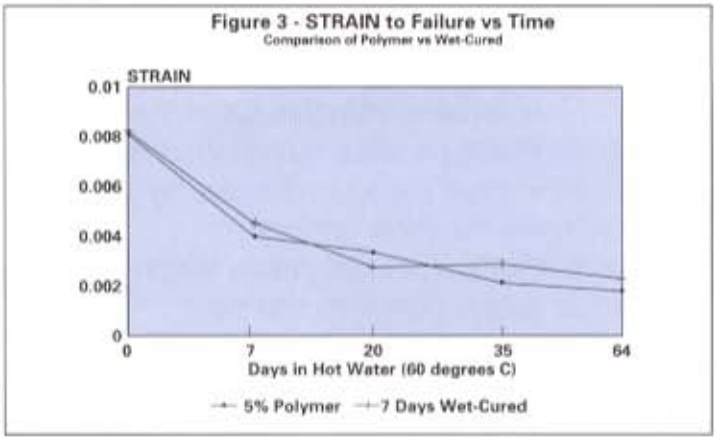
Test Result	Age (days)	5% Polymer	Wet Cured
LOP (psi)	7	1174	1031
	28	1213	1153
MOR (psi)	7	3279	2851
	28	3227	2897
Strain to Failure %	7	.00961	.00842
	28	.00815	.00826

The physical properties, after accelerated aging are shown in Figs. 1-3. The test specimens, both polymer-containing and non-polymer-containing GFRC, were aged in hot water at 60°C, and a series of tests were taken periodically up to 60 days (equivalent to about 50 years of natural weathering in a temperate climate).

All tests show that POLYPLEX, in the amount of 5% solids to the weight of dry cement, provides full curing of the Portland cement, at least equivalent to seven day wet curing without polymer. Further POLYPLEX has no detrimental effects on long term properties.







POLYPLEX SPECIFICATIONS

Type compound	Aqueous thermoplastic copolymer dispersion	Avg. polymer particle size	150-200 mm
Type polymer	Acrylic based	Molecular weight	Approximately 400,000
% Solids	47% 1% by weight	Ultraviolet resistance	Good (weatherometer 500 hrs)
Free monomer content	Maximum 0.2% by weight in dispersion	Alkali resistance	Good
Appearance	Milky white, creamy, free from lumps	Viscosity	300 CPS
Odor	Meets OSHA and EPA requirements	Freeze-thaw stability	No gelation in a minimum of 5 cycles
pH	8-10	Specific gravity	1.05
Minimum film forming temp.	Approximately 50°F		

MIX FORMULATION

The recommended polymer content is 5% polymer solids to the weight of dry cement. For a mix based on one bag of cement (94 lbs.) the **POLYPLEX** content is calculated as follows:

94 x 0.05 = 4.7 lbs.

This is the weight of polymer solids needed. The **POLYPLEX** emulsion contains 47% polymer solids, so the amount of emulsion that will give 4.7lbs. of solids is:

4.7/0.47 = 10 lbs.

In calculating the mix water it must be remembered that the **POLYPLEX** emulsion contains 53% water which must be allowed for as follows: For a water/cement ratio of 0.33 the total water required is:

94 x 0.33 = 31 lbs.

10 lbs. of **POLYPLEX** emulsion contains

10 x 0.53 = 5.3 lbs. of water

Therefore the extra mix water required is

31 - 5.3 = 25.7 lbs.

A typical mix formulation is as follows:

Cement	94 lbs.
Sand	94 lbs.
POLYPLEX	10 lbs.
Water	25.7 lbs.
Superplasticiser	as required to give desired fluidity.
5% NEG H103 roving	11.8 lbs.

N.B. Some additives, such as some superplasticisers, water reducers, set accelerators and retarders may not be compatible with acrylic polymers, particularly when used in combination. If flash setting or other slurry problems occur, it may be due to this incompatibility.

MIXING PROCEDURE

POLYPLEX can be incorporated into GFRC slurry mixes using most types of mixers, including high shear and paddle mixers. The important thing, however, is to avoid excessive mixing time, as this can cause break-down of the polymer and loss of its effectiveness. Mixing times should be kept to less than five minutes.

POLYPLEX contains a defoamer which prevents the polymer from foaming during mixing and so entraining air in the composite. This would reduce the composite density and adversely affect strengths. Densities of GFRC mixes containing **POLYPLEX** should be comparable to wet cured GFRC.

CONDITIONS OF USE

STORAGE AND HANDLING

POLYPLEX is delivered in 55-gallon drums (475 lbs.) It is supplied as an emulsion comprising 47% polymer solids and 53% water. Because of this it can freeze and, although it is freeze-thaw stable for 5-cycles, it should be stored in an area where it will be protected from freezing.

POLYPLEX has a shelf life of about 12 months, so it is important to rotate stock on a first-in first-out basis.

POLYPLEX does not have special EPA or OSHA handling regulations; material safety data sheets are available on request.

SPRAYING

GFRC slurries containing **POLYPLEX** should spray similarly to non-polymer slurries. However, it must be noted that **POLYPLEX** forms a film when it dries. Therefore it is important, immediately after spraying stops, to keep spray guns washed through with water, particularly the nozzles. It is important **not** to blow air through when not spraying, as this will cause the polymer to film-form. This could result in build-up in the nozzle and cause subsequent blockage.

CLEAN-UP

POLYPLEX, like other polymers, has good adhesive properties, which can create clean-up problems if good housekeeping is not practiced. Concrete build-up can be prevented if equipment is coated regularly with mold release. The mold release facilities removal of concrete build-up on equipment at the end of production.

CONDITIONS OF USE, cont.

CURING PRACTICE

During the initial cure period of around 12 hours, the temperature should not be allowed to drop below 50°F, or exceed 120°F, or the film-forming action of the polymer will not take place, thereby making it ineffective as a curing aid.

Once the film has formed, it is largely unaffected by the environmental conditions and will continue to retain water in the composite through wide variations of temperature and humidity.

However, since the polymer does not take part in the hydration process of the Portland cement, the conditions of storage should be kept above 55°F so as not to inhibit cure of the cement.

OTHER USES

In architectural panels and other products with aggregate face-coat and mist-coat finishes, it is recommended that these also contain **POLYPLEX** at about the same level as the GFRC back-up mix. This will help in maintaining compatibility between the face or mist-coat and the GFRC back-up.

This will not affect sandblasting but, as **POLYPLEX** confers acid resistance, acid etching may be difficult.

Also, if a painted finish is to be used, adhesion tests should be run because the polymer film may adversely affect adhesion or penetration of the paint to the substrate.

POLYPLEX can be used as a bonding agent for patching or bonding-pad repairs. **POLYPLEX** can be added to the patch or bonding pad mix, or it can be brushed onto the surface to be repaired.

POLYPLEX will improve adhesion of the patching material or the bonding-pad to the cured GFRC, but it is essential that the repair material be applied before the polymer begins to dry. Once dry, the polymer will have film formed and it will impair adhesion, rather than improve it.

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