HOW CEMENT WORKS?

Cement as we know it, has been around for less than 300 years, before that mortars were made from clays, crushed shells and lime. So most of those marvelous old mosaic murals in Europe and the Middle East were installed without cement. Most brick houses built in Australia before 1945 were also constructed with lime mortar between the bricks and with lime mortar and plaster set for the interior linings. The first patent for a cement type product was taken out in 1824, by Joseph Asdpin, a British stone mason who called the product he first made in his kitchen oven, Portland Cement, because it gave a light grey finish like the stone from the Isle of Portland. Portland cement was expensive because the ingredients had to be crushed, fired to over 1000° C, then finely ground to a powder. Cement became cheaper with mass production techniques introduced after World War II, and so plasterers and bricklayers stopped using lime mortar and joined tilers, who had traditionally used cement mortar for tiling in wet areas.

What is cement made of?

The key ingredients of cement are, coming from crushed limestone and chalk, Gypsum, and a Silica Alumina Iron mix usually made up of clay Bauxite and Iron Ore. The ingredients are crushed, fired at up to 1500° C, crushed again, blended, milled, de-watered and bagged.

What types of cement are available?

Dozens of types of cement are available including ones that provide high early strength (HE) , or that set rapidly. Some are specially formulated to protect concrete from salt and sulphate attack (SR) but the hardware store or builders supply outlets usually stock “General purpose and blended cement in grey or “off white”. General purpose cement is recommended for tiling work, and it is worth noting the “off white” cement shrinks slightly more on setting than grey, Pure white cement (imported) shrinks markedly more than grey cement.

What happens when water is added?

When water is added to cement a process called “hydration” occurs. The water causes each finely ground cement particle to start to grow tiny crystals “fuzz ball” with the crystals filling the space in and around each other.

The crystalline structures form around sand and aggregates and lock into the backs of tiles, bricks and other surfaces.

After about 3 days the crystal growth stage is largely over, by which time, everything involved in the mix has become inextricably entwined. Cement, therefore, goes through an “initial set” in one or two hours, a “final set” in 6 to 12 hours and finally a curing or hardening process (which can go on for months). **Anything that interferes with the formation of the Ettringite needles (crystals) can dramatically weaken the cement mix.** The crystals need time to grow. For most tiling purposes, one day curing is enough but 3 days is better. If the mortar dries out too quickly the Ettringite crystals simply stop forming. Therefore, less interlocking takes place and the mix is weakened. This is why so much effort goes into “curing” concrete properly. It is hosed down to keep it moist and waxes, hessian and “curing compounds” are applied after screeding to reduce moisture loss.

However, while cement is mostly used in concrete many people use cement in largely “non structural” ways, and they often take no steps to try and promote a slow, moist cure for their mortars. Rapid drying of the cement mix can reduce mortar strength by up to 30%. Complete drying of the mix could happen, for instance for hot weather exterior tiling, within hours. Sometimes the grout goes hard and white in less than an hour. This is a disaster for grout strength. Another way in which crystal growth is damaged is if the mix is re-tempered. Re-tempering simply means more ware is added and the material is re-mixed after it has had its initial set. Re-mixing will break off many of the crystals and any new crystal growth will be short and incomplete. A weakened mortar is the result.

Too much water is the enemy of good mortar.
Builders, engineers and concreting professionals know that when extra water is added to a mix, it becomes easier to place in position, but its strength will drop, The crystals don't become as tightly packed when the mix is like soup. They just can't fill all the spaces, the cement paste is too thin for adequate strength formation. According to the Cement and Concrete Association of Australia, the addition of 30L of water (2 household buckets) to a 300 kg batch of concrete would reduce it's final strength by a whopping 30%*

This 30% drop n strength is cumulative, and can be added to the 30% loss of strength that can occur if the mix dries out quickly. **For example, a runny grout mix used on a exterior tiled deck where the sun dries the joints white within an hour or so, could lose up to 60% of its strength.** This grout will erode and not perform its function. It will also be very vulnerable to attack if the surface of the tiling is cleaned with a hydrochloric acid solution. Hosing the surface down, or covering it with damp sand would improve the hardness of the joints by promoting a slower cure.

Proprietary grout mixes, such as those made by the large tile adhesive manufacturers, contain plasticizers to make grout pliable without having to add too much water. They also contain "water entrainers" which help to slow moisture loss. Such proprietary grouts consistently out perform site mixed grouts, but obtaining a consistent colour can be difficult with any grout. This was the subject of an earlier article in Tile Today,

Cement based adhesive also contain plasticizers and water entraining additives. This means they perform better than ordinary sand and cement mortars as they cure more slowly thereby improving the hydration process. Tilers can improve size batched mortars by including commercially available mortar additives such as the latex polymers available from most tile adhesive manufacturers.

So the message is:

Proprietary cement based products have been formulated to out perform site batched mortars and grouts, but no matter what mix is used, it should only have sufficient water added to provide the required working properties, and it should be allowed to dry out slowly.

***Cement & Concrete Association Information Bulletin, October 1995. (Page 8)**

Should you require any further information,
please contact our Technical Team on 08 9441 6677 (Response within 24hours)
Geoff Hoddy 0417 144 860 or Bevan Morgan 0422 946 599