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Plastic Curing Tarp and Chamber for Curing Concrete

Background

For some time development workers have promoted the small-scale production of concrete products as an income generation activity. The main product has been roofing tiles. After casting, the concrete roof tiles are kept in curing chambers until they pass a strength test. Curing can be done by immersion in water or, where plastic tarps are available, in water vapour under a plastic tarp. This article focuses on the plastic covering for solar powered high humidity curing chambers and on the design of easy-access curing chambers.



A water curing chamber

Cement comes in a powder form. When it is mixed with water a chemical reaction begins resulting in a strong binder. This chemical reaction can take many years to complete. Initially the chemical reaction happens very fast; about 80% of the reaction happens in the first 28 days after adding water. Usually roof tiles are cured in a curing chamber for about 7 days. While curing the chemical reaction needs a constant source of water. If the concrete dries out, the chemical reaction will stop.

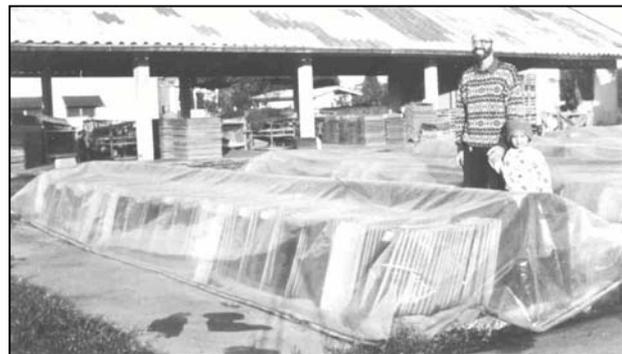
When concrete tile production was first promoted (about 1978), the tiles were cured in tanks filled with water. The tiles had to be cured for about 3 weeks before they would pass the strength standard. After some years it was discovered that curing could be done in a water tank with just a few centimetres of water in the bottom, as long as the top was covered'. One surprising thing about this was that the roofing tiles passed the strength test much faster: in about 1 week. In most cases the covering was a black plastic tarp.

When we consider that most chemical reactions happen faster at a higher temperature we find this result not so surprising. Immersing in water is cold. Curing with a little water under a plastic tarp is hot and humid. In industrialised countries concrete products are often cured in 8 hours in steam rooms fed by boilers. Boilers are very capital intensive, having an efficient solar curing tarp that gives us a high temperature is an appropriate alternative.

Solar Concrete Curing Tarps.

A clear plastic tarp is much more efficient than a black plastic tarp. This is because a clear plastic tarp will let more light energy through to the concrete. With a clear plastic tarp we will have hotter concrete and cooler plastic than with a black plastic tarp.

Some clear plastic tarps are better than other clear plastic tarps. Ideally we want a plastic which will let in as much sunlight as possible and trap it inside as heat. In scientific terms we might say we want a plastic that is



A high-humidity easy-access solar curing chamber

transparent to ultraviolet light (the majority of light from the sun is this) and opaque to infrared light (infrared light can't be seen by the human eye, but it can be felt; we usually call this light "heat."). We also want the tarp to be durable and to not let water vapour out.

Several different plastics were tested on a curing chamber to see which one would trap the most heat. A composite of a typical day is shown here:

Curing Cover Performance

<u>Plastic</u>	<u>Highest Temp</u>	<u>Lowest</u>
Clear, LLDPE (Polythene) 0.300 mm	63°C	31°C
Clear, Tedlar® (Polyvinylflouride)	62°C	31°C
Clear, PVC (Polyvinylchloride) 0.300 mm thick	65°C	31°C
Black, PE (Polythene)	56°C	31°C
The ambient temperature on this August test day was	36°C	27°C

Some interesting things that we can see from this testing are:

1. Black plastic gives a much cooler maximum temperature than clear plastic.
2. There is not much difference in maximum temperature between clear plastics.
3. No plastic keeps in the heat better than any other does.

The conclusion we can draw from these tests is that a higher temperature will always result from a clear plastic.



An easy-access curing chamber

Reduced curing time means fewer curing chambers are required and less stock is kept in the curing chamber. Having excess capacity of curing chambers is not necessary. There are other factors affecting the time it takes for a product to pass a strength test. Things that increase the curing time include: using a lot of water in the concrete mix, a cold temperature. Things that reduce the curing time include: using less water, using a superplasticizer (a chemical additive

Please note that roof tiles at the CVBT pass strength tests after 5 days (or less) at the above temperatures. We must ask how much effect temperature has on the time it takes to cure concrete. One concrete expert explains it this way:

“If the temperature of the water is - let's say - +25°C and you have found out that the tiles should be stored in water for 5 days, you will have to store the tiles for 6 days if the water temperature is + 20°C, for 8 days if the water temperature is +15°C, for 13 days if the water temperature is +10°C and for 22 days if the water temperature is +5°C.”ⁱⁱⁱ

This is saying that the higher the temperature the less the effect on the curing time. So, it is not necessary to have the most efficient plastic. Even a black plastic can give a high temperature.

Reducing the curing time is one way to reduce the amount of capital investment required and the amount of working capital required.



An easy-access curing chamber can be stepped into.

that reduces the amount of water required to pour the concrete), a mix with a high cement content, or a hot curing temperature.

Easy Access Curing Chamber

It is useful to have a curing chamber that makes it easy to put products in and take them out. One which has walls all around forces workers to lift the products up and over. Sometimes the products will hit the wall and be chipped or break. Also, the plastic covering will sag or tear when it rains. It is better to have a curing chamber that has a place to lean products but does not have walls. Workers do not have to lift the products up high. The plastic rests directly on the concrete and will not sag or tear when it rains. It costs less too.



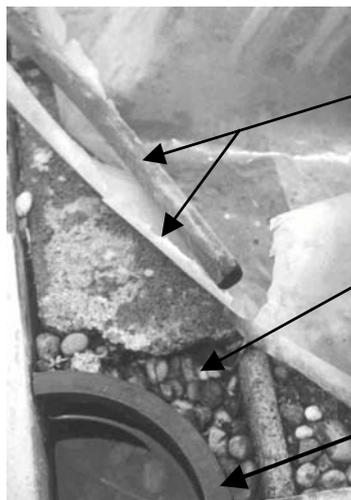
Sewing a concrete curing tarp

Materials and Fabrication of Equipment

Solar Concrete Curing Tarps

Polythene (also called polyethylene or PE) is best. It should have a UV stabiliser; if it doesn't, it will last only a few months. PVC does not last as long as PE and is more affected by high temperatures. The plastic comes in rolls of 50 or 100 yards, and in various widths. A thickness of at least 0.25-mm should be used. It can be cut with scissors and sewn on a heavy-duty sewing machine. Nylon thread should be used. Cotton thread will deteriorate in the caustic cement environment.

The edges may be folded over, sewn and a plastic hose inserted. This provides some weight so that a wind will not easily blow the tarp open. Always use a new plastic hose; old hose turns black and gets very hot (see photo). Too much heat will make the plastic tarp brittle and crack.



To weight the tarp, an old hose was sewn into it. The hose turned black and reached high temperatures making the plastic tarp brittle and crack.

The curing chamber trough is filled with stones and topped with concrete blocks. Then it is filled with water.

Water level inspection opening

Easy Access Curing Chamber

A curing chamber can be made from a concrete floor with a leaning wall made of concrete blocks or bricks or stabilised soil blocks. It must be waterproofed.

Make sure the floor is poured before the blocks are mortared. If the blocks are used for the formwork, the curing chamber may leak. The floor does not have to be reinforced with steel bars but it should not be too long or it may crack and leak. It should have a good base so that the chamber does not sink.

The trough is filled with stones; concrete blocks laid on top (not mortared); then water is poured. A small overflow channel is a good idea to prevent products from getting wet and getting white efflorescence on the edge

Usage

Solar Concrete Curing Tarps

The tarps should usually be open only in the coolest and will lose the least amount of heat. Also, in the afternoon the products may be covered.

In the case of concrete blocks or stabilised soil blocks directly in the stock area and then cover with a tarp. This is a lower cost. The moisture inside the blocks may be lost.



Cover the last tile with a "grade B" tile to prevent shrinkage cracks.

need to move the blocks in and out of the curing chamber. There will be a limit on how high the blocks can be stacked because they are not yet strong and the ones lower down will have to support some weight.

Easy Access Curing Chamber

The water level should be checked daily. When there is only 2 centimetres of water left, more water should be added. Adding water sooner than necessary will cool down the curing chamber. If water has to be added frequently, the chamber should be checked for leaks.

If freshly poured concrete dries out too fast it will crack. The last tile in each row should be covered with a fully cured tile (a grade B tile is useful for this).

Limitations

Solar Concrete Curing Tarps

Most of the plastics will last for 3 to 5 years. They can be patched if torn.

Easy Access Curing Chamber

This type of chamber is good where a clear plastic tarp can be bought. If plastic tarps are not available then a water-curing tank is more appropriate.

Equipment Plans

Plans for curing chambers and tarps are available from the CVBT (see address above). Please include \$US 15 to cover postage and handling. Plans are also available from:

Development Alternatives

B-32 Tara Crescent
Qutab Institutional Area
New Delhi 110016 INDIA
Phone 91 11 696-7938, 685-1509 FAX 91 11 686-6031
Email tara@sdalt.ernet.in

ISAT/GATE/GTZ

PO Box 5180
65726 Eschborn GERMANY
Phone 0 61 96 - 79 31 85
FAX 0 61 96 - 79 73 52
Email gate-isat@gtz.de

Groupo Sofonias/EcoTec

Apdo 88
Jinotepe, Nicaragua
CENTRAL AMERICA
Phone / FAX 00 505 42 23-325
Email sofonias@compuserve.com

Shelter Forum

PO Box 39493
22 Chiromo access Road,
Off Riverside Drive
Nairobi, KENYA AFRICA
Phone 254 2 442108
FAX 254 2 445166
Email elijah@itdg.or.ke

Equipment Suppliers

CVBT: (see address above) Custom tarps are available from the CVBT. Typical Price for a 3 metre x 6.3 metre tarp (including shipping) U.S.\$55.00 Allow 6-8 weeks for delivery. Specify length and width.



An overflow pipe helps prevent liquid water from touching the concrete products and causing efflorescence.

Other Equipment Suppliers:

Contact a local plastic tarp supplier. One place to ask is at shops that make furniture, awnings or seat covers. These stores usually stock PVC tarps which do not make good curing chamber tarps, but these stores purchase plastic tarps from manufacturers which may produce PE tarps as well. Agricultural or nursery supply stores may also have some clear plastic tarps.

References

ⁱ Manuel de Rivero, "Solar Curing Increases Production Efficiency in Peru," FCR - News Issue Number 6, February 1990

ⁱⁱ "The FCR-Expert answers," FCR - News Issue Number 6, February 1990