Vertech Hume P/L, Werribee, Victoria 3030, Australia

AS SEEN IN
CPI Concrete Plant International
Trade Journals for the Concrete Industry

Innovative production method for reinforced concrete poles

Australian concrete pole manufacturer Vertech Hume have developed and commercialised an entirely new process for manufacturing reinforced, round, hollow, concrete power poles using a radical new instant strip technology developed in Australia.
'Vertech Hume's Instant Strip Production Plant' was first featured in CPI magazine in February 2007, the same year Vertech Hume won an Australian Government Award for 'Australian Engineering Excellence'. At that time, the technology was embryonic, today it is mature, with an output of 3000 poles per mould per annum. The Vertech Hume Instant Strip process supplies much of the Australian market and has won many multi-year contracts ahead of traditional spun technology competitors.

The Vertech Hume instant strip technology

The "Vertech Hume Instant Strip Production Plant" pumps 1 cubic meter of concrete vertically into a pole mould and 'de-moulds' it twenty minutes later. The process is static (no spinning) and involves removing 'free water' from the freshly cast concrete, producing concrete of 1-2 MPa which is strong enough for a wet concrete pole weighing two tonne to be hung vertically from the reinforcement cage and immediately transported for curing. The complete cycle takes just thirty minutes.

There are two sorts of water in fully mixed concrete, water that is required to wet each particle and free water that fills the spaces between the particles. It is this free water that the process removes. The concrete mix consists of water, Portland cement and aggregates. No additives are required keeping the batching simple and cheap.

The mould is similar to many used in the manufacture of hollow, circular, concrete poles. It is the way the mould is used that is truly inventive. The Vertech Hume moulds are supported vertically on a mast. The two halves of the mould move horizontally, controlled hydraulically, coming together to form a single cavity, sealed with hydraulically operated sliding locks that are opened and closed in seconds allowing the moulds to be driven apart, ejecting the concrete pole.

The poles hollow centre is created not by spinning but by a core that forms the tapered mould cavity that the pole is cast into.

A reinforcement cage is hung in this tapered mould cavity, once in place the mould is closed, the cage held concentrically between the outer moulds and the core guaranteeing a consistent wall thickness.

The core is lowered 14m vertically into position inside the reinforcement cage using a standard hoist. See step 1, fig. 1. It is for this reason that the Vertech Hume Plant is thirty meters high, over twice the height of the pole and moulds. Casting vertically

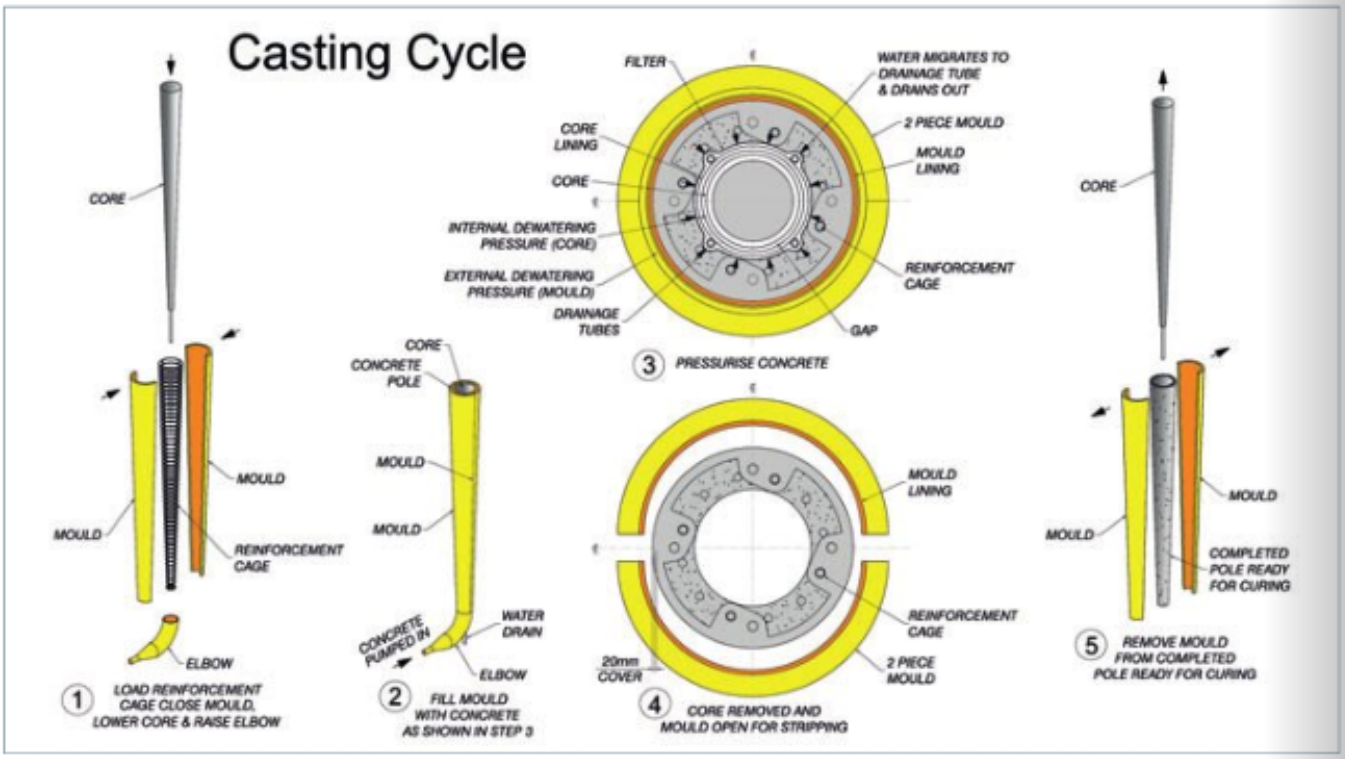


Fig. 1: Casting Cycle

saves money in land cost with the plant using only 120 sqm of land.

With the reinforcing cage in place and the mould closed, the concrete pump line is connected and the pole is cast. This takes 4-5 minutes. See step 2, fig. 1. The concrete is pumped from underneath and once the mould is filled the inner core is pressurised compressing the concrete.

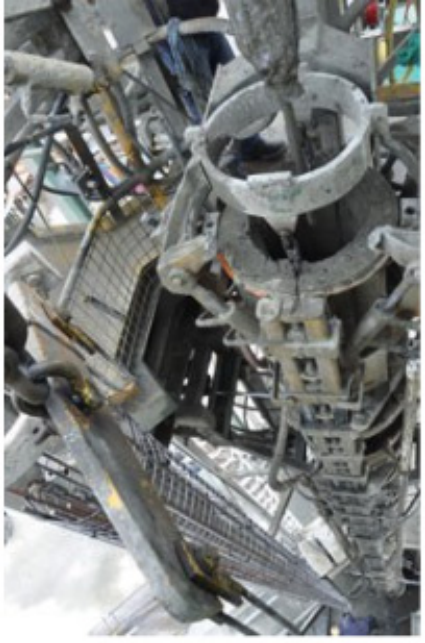
See step 3, fig. 1. A pressure of approximately 250kPa is applied by a rubber bladder which surrounds the core. The bladder has a filter cloth and drainage system through which only the free water flows, all aggregates and cement particles remain in the concrete, reducing the water to cement ratio to 0.32-0.33. This operation takes 15-20 minutes after which the pressure is released and the inner core is removed vertically, the pole is de-moulded and hung in the vertical steam carousel to be cured. See step 4-5, fig. 1.

At this stage the low water to cement ratio and the cohesive mix becomes apparent because the wet concrete is now supported entirely by the reinforcement cage.

The compressive strength of the freshly cast uni-directionally compacted concrete is of exceptional quality after only 20 minutes at approximately 1-2 MPa making it possible to strip the still green concrete cleanly away from the surface of the mould with no preparation required for the next casting operation. The mould is re-set for immediate re-use; no release agents of any kind are used.

The combination of mix design, pressure, vacuum, time, filter and mould liner materials is the secret to the success of the revolutionary technology. Combining the high strengths of spun casting and the simplicity of static casting in one operation has delivered a technology that is commercially favourable. But secrets to the success are not immediately obvious. On the one hand consideration had to be given to good pump ability as there is considerable restriction caused in pumping the concrete through and around the reinforcement, here the need for the mix to retain water is important, on the other hand the need to finish with a low water cement ratio, a smooth outer surface and a cohesive matrix was equally important.

During the casting of trial poles it was found that by adding fines to reduce the segregation of the water the surface finish and the strength of the matrix would deteriorate. A mix design that is high in fines and holds its



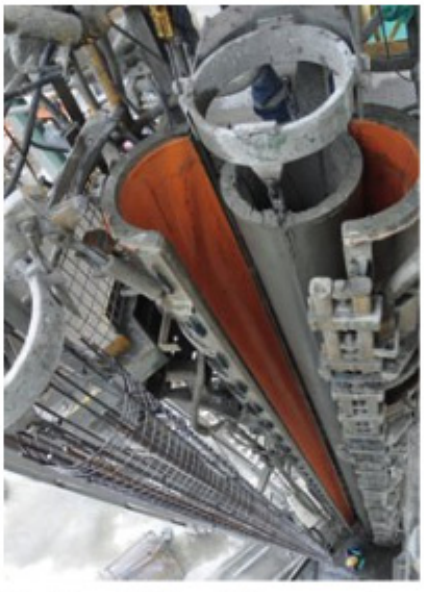
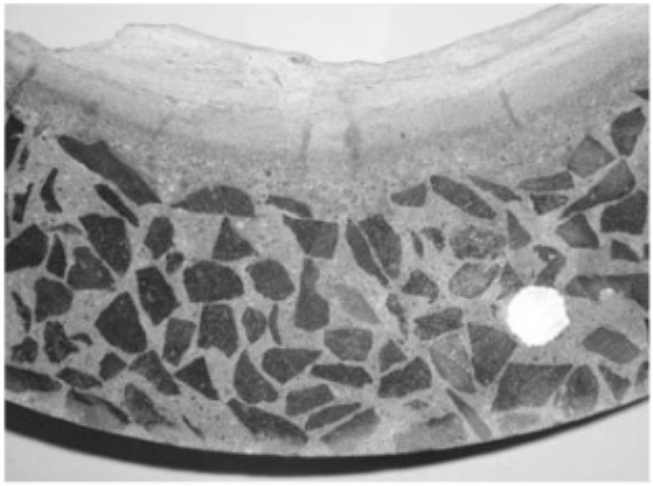


Fig. 2,3 and 4: De-moulding process of fresh poured poles.



Typical cross sections:
Fig. 5: Spun cast cross section

Vertech cross section

water well is not a mix that will easily let its free water go. To design and experiment with alternative mixes a small test mould was made that would closely duplicate what was happening in the pole mould. By trial and error it was found that a mix that compacted well gave an excellent surface finish and provided a final water to cement ratio of about 0.35. It was not expected that it would pump well because the mix released its water so easily. However, it was found the pump pressures were mid-range and the surface finish was excellent and satisfied the Australian specification. The benefits of this process are evident. In a spun pole the larger aggregates finish up against the mould surface with many of the fines on the inside, this low density inner surface of fines is known as Laitance.
The Vertech Hume Instant Strip process very evenly and effectively distributes fine aggregate and cement throughout the matrix giving a far more uniform concrete. The water absorption figures for the concrete are excellent meeting the Australian/ New Zealand Standard of >6.5% Importantly for a concrete sample from a spun pole to meet this low water absorption figure the "water absorbing laitance" on the inside of the pole must be removed. Industry now accepts that this low absorption figure achieved with the instant strip method produces a superior product having greater resistance to corrosion.

New Definition of Productivity

We now know the process stands up to the demanding and harsh environment of a concrete plant, how reliable the technology is, what daily maintenance is required, and that high quality can be maintained consistently. The great benefit of casting statically without vibration is there are less parts and they are all slow moving so wear and fatigue of components is almost non-existent. This is very important if true continuous casting is to be achieved. Vertech Hume believe most components will have a life expectancy of 30 years or longer.
Even repair and eventual replacement of synthetic materials such as the filter cloth used on the core to filter the "free water" only represent 0.33% of the per pole cost. These filter cloths are removed at the end of the shift, washed with high pressure water and refitted for the following shift. The time taken to remove, wash and refit is 15 minutes and requires one man.
The mould liners have also proven incredibly reliable. Any cement particles remaining on the mould liners are fresh and are combined with the next pole when it is cast; in hot weather a one minute wash down every 3-5 poles prevents any further build-up over the short term. Mould liners are cleaned with hydrochloric acid every 350-400 poles cast, no release agents or mould oils are used. The liners are lasting for 8,000 - 9,000 poles and take only 2 working days to replace. These are most unexpected outcomes and achieved from off the shelf materials operating in a very aggressive environment.
Production output is important but unless it can be combined with quality then all is lost. Again the Vertech Hume Instant Strip technology provides a high and consistent quality. The design mix starts with a water to cement ratio (W/C) of 0.5-0.55. This high slump concrete is very easy to pump and place. There is no, pump aid, defoamer or superplasticizer required. Unbelievably, no moistures tests on aggregates are required and no previous concrete experience needed to batch the concrete.

By removing the "free water" a final water to cement ratio of 0.32-0.35 is automatically achieved guaranteeing excellent concrete strength and durability. This is vastly different from the spun technology. One aspect of the process that helps with consistency is the known volume of the mould cavity that the concrete is cast into.

When the mould is full the pole has an even distribution of concrete throughout the pole guaranteeing product weight, the centre of gravity and wall thickness further ensuring the concrete supports the steel reinforcing cage as it is engineered to. Importantly the inner surface of the pole has no laitance. Laitance is dangerous. Laitance (the soft layer inside the spun pole) absorbs ground moisture and leads to a rapid deterioration of the concrete and corrosion of the reinforcement shown to reduce pole life to as little as 5 years in extreme conditions.

Labour and Safety

The success of a manufacturing plant relying on people must consider them in its design. Firstly, the fewer men required the cheaper the product. The Vertech Hume Instant Strip technology requires 25% less man power per pole than the spun system. The Vertech Plant requires 4 men to run it

Vertech poles ready for dispatch

and they rotate every two weeks so the business is not dependent on individual people.

The technology also provides a safer work place. There is no spinning, rolling or craning of moulds. A safer work place means lower insurance. There is less than half the number of crane movements when compared to the spun process. This reduces the risk of damaging the product and the people, and lower noise levels lead to less worker fatigue and higher productivity.

Summary

All the predicted outcomes of the Vertech Hume Instant Strip System have been realized and proven in a competitive market place. In 2014, seven years after conception this technology is fully resolved, commercialized, patented, risk free and ready to deliver to new markets. ■

FURTHER INFORMATION

VERTECH HUME

Vertech Hume P/L
64-66 Lack Avenue
Werribee, Victoria 3030, Australia
T +61 3 9742 5277
F +61 3 9742 7060
info@vertechhume.com.au
www.vertechhume.com.au