New Markets for Magnesia

What are tec, enviro and eco-cements, why are they so important, what do they mean for the industry?

John Harrison is the managing director of TecEco Pty. Ltd., the company behind these new innovations. He has degrees in science and economics, works tirelessly to find ways of "materially" improving the sustainability of the built environment and in recent times has concentrated on the research and development of TecEco cement and kiln technology. We asked him to answer some questions.

What are Tec, Eco and Enviro – Cements?

John postulated that the weakness of Portland cement concretes is the lime in them that is released during the hydration of Portland cement. To him the obvious thing to do was remove the lime utilizing the well known pozzolanic reaction, but unlike others, he considered the addition of another alkali to stabilize calcium silicate hydrates was essential. What is interesting to producers is that John adds reactive magnesia (caustic calcined magnesia or CCM) which hydrates in the mix forming brucite.

In tec-cement concretes the amount of magnesia is usually between 5 and 10%. There are however many other ramifications. The rheology or behavior of the mix whilst being placed is improved, durability is significantly improved as is strength. It seems as though tec-cements are stronger because the hydration of magnesia internally consumes water resulting in greater density and concentration of alkalis the consequence of which is significantly improved pozzolanic reactions. Other advantages include the elimination of shrinkage and bleed water.

In a porous environment both lime (Portlandite to cement chemists) and brucite will hydrate, adding strength by forming carbonates and this is the basis of the much publicized eco-cements. The difference between the calcium and magnesium carbonates that form is that the latter are generally hydrated and also add micro structural strength because they are generally fibrous and acicular. For example lansfordite is 77% water and carbon dioxide which is a lot of binder for not so much magnesia. The good news for manufacturers is that because magnesium carbonates add more strength than calcium carbonates it makes sense to use higher proportions of magnesia in the mix.

Be warned that it is essential to use highly reactive magnesia, as the only possible downside of the chemistry of John's new innovations are delayed reactions if the lattice energy becomes significant, as would be the case with less reactive magnesia or periclase. The key to making highly reactive magnesia is to keep the temperature down during the calcinations period. John has designed a new kiln that combines calcining and grinding and runs on non fossil fuel energy that will make highly reactive magnesia with less variation in properties of each and every particle. As grinding is very inefficient and releases a lot of heat, the kiln requires less energy to operate and is therefore also potentially cheaper to run.

Why is the New TecEco Technology so Important

The fact that global warming is substantially the result of our fossil fuel burning activities on the planet is irrefutable science. John says the convincing argument for him was that the rate of change in the concentration of the gas in the atmosphere is ten times greater that the geological record indicates could be the result of natural change.

According to many scientists we have a 10 year window to reverse the rise in the level of CO_2 in the atmosphere before massive problems including flooding of low lying cities like New York, London and Tokyo are inevitable.

We move some 5 or 600 billion tones of material around the planet every year. Of this usefully some 50 billion tones. With production at just under 15 billion tonnes per annum, concrete represents around 30% of that. To make 15 billion tones roughly 2 billion tonnes of cement is manufactured every year. To put that into perspective the production of reactive or caustic calcined magnesia is only some 1.7 million tonnes per annum.

Concrete is already the most sustainable of all building materials having the lowest embodied energy.

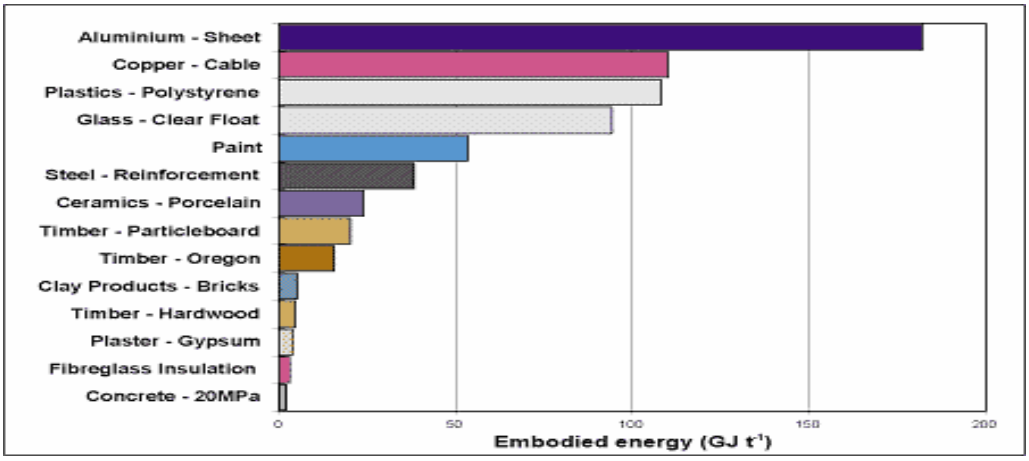
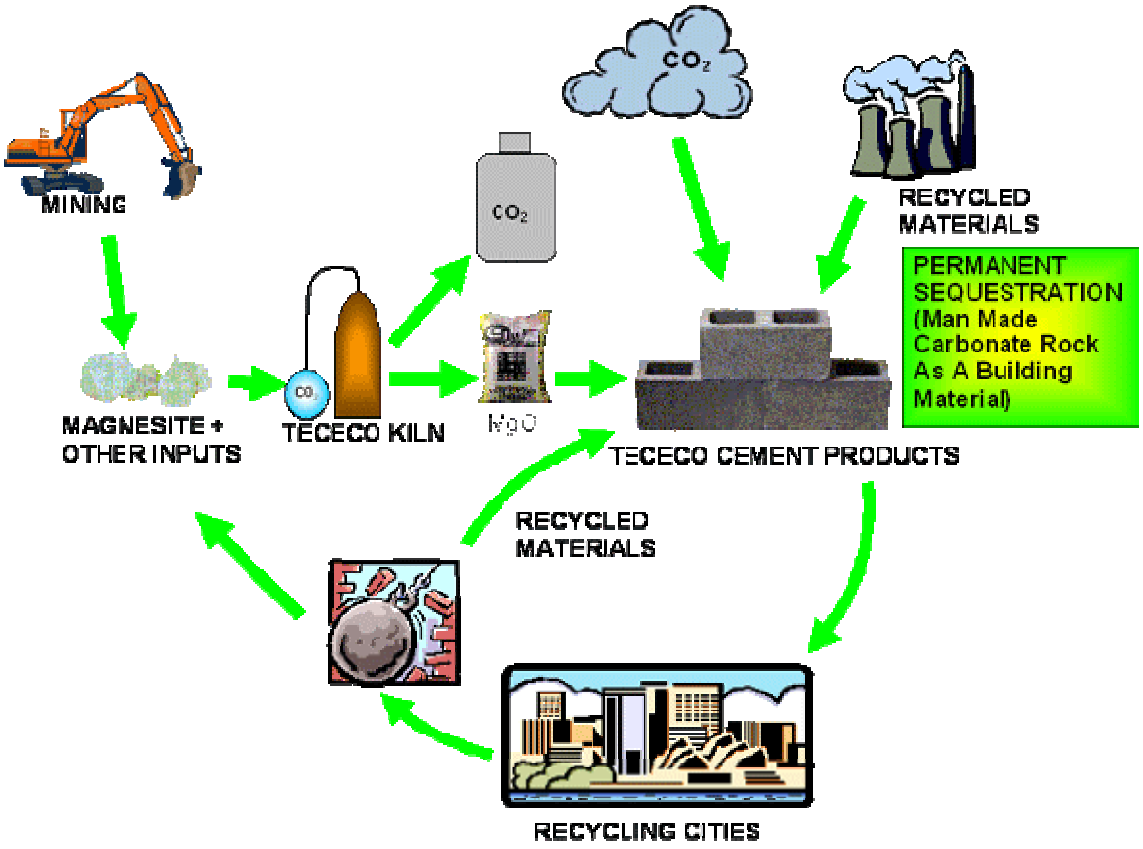


Figure 1 - Embodied Energy of Building Materials (Tucker, S., 2000)

The problem is however that for every tonne of Portland cement made approximately one tonne of carbon dioxide is released into the atmosphere.

John's research has shown the world that by substituting reactive or caustic calcined magnesia for Portland cement in a concrete the net emissions can be significantly reduced. A reduction of around 30% is possible for tec-cement concretes and much more for eco-cements which, depending on the formulation, can even be a net carbon sink.

The built environment is our footprint on the planet, it represents around 70% of all materials flows and is the obvious place to put carbon dioxide and other wastes. The concept of mimicking nature in which many animals and plants build their support structures using carbon makes a great deal of sense and eco-cements do just that as they set by absorbing carbon dioxide out of the air. Using eco-cements cities could absorb more carbon dioxide than the forests they replace.



What Does All this Mean for the Industry?

As we are going to have to sequester massive amounts of the gas if we wish to prevent climate change from getting much more dramatic the future for TecEco's technologies is bright.

If John is right the requirement for magnesia will significantly increase. At a substitution rate of 10% (which is on average low) then the amount required given a 1% market penetration would be near enough to another million tonnes. Realistically the new markets the new TecEco technology will create will be many millions of tonnes.

Mahatma Gandhi said "You must be the change you wish to see in the world." John says "You can't change the world on your own" and invites anybody from the industry who wishes to get involved in this exciting project to make contact with him (See www.tececo.com).