New materials claim eco-friendly tag

We may be on the verge of a technology and materials revolution that promises lower construction costs and a solution to problems such as global warming, waste and housing for the masses.

By JOHN HARRISON

CONSTRUCTION techniques and materials that have not changed much since the time of the Romans are all set to change.

I was recently in California talking to a professor at the University of Southern California who has developed equipment and software enabling him to construct much of a building robotically. Holding up the adoption of robotics for constructing entire subdivisions, skyscrapers and even new cities from scratch is not the computer software nor the hardware. The hurdle is the material that will in future form the substance of much of the built environment.

To enable placement and finishing in a single pass of a robotic device, the materials used will have to behave like toothpaste; so that they can be pumped and squeezed out of a nozzle and stay exactly where and how they are placed for finishing by robotic trowels.

TecEco binders have this property mainly because of the unique affect of a small highly charged Mg ion in solution on water which is a highly polarised molecule required for setting hydraulic cements.

The use of fibre reinforcing of these new cementitous composites will provide the strength necessary. Various wastes could provide various properties such as lighter weight, tensile strength of insulating ability. A little like a colour ink or bubble jet printer uses different colours for different parts of a plan printing job so to could a robotic arm working 24 hours a day seven days a week without a break use different materials for different purposes.

So far there are three main formulations that have been developed. Tec-cements (5 to 15 percent MgO, 85 to 95 percent OPC) contain more Portland cement than reactive magnesia. Reactive magnesia hydrates in the same rate order as Portland cement forming Brucite which uses up water reducing the voids:paste ratio, increasing density and possibly raising the short term pH. Reactions with pozzolans are more affective. After all the Portlandite has been consumed Brucite controls the long term pH which is lower and due to its low solubility, mobility and reactivity results in greater durability.

Eco-cements (15 to 90 percent MgO, 85 to 10 percent OPC) contain more reactive magnesia than in tec-cements. Brucite in porous materials carbonates forming stronger fibrous mineral carbonates and therefore presenting huge opportunities for waste utilisation and sequestration.

John Harrison believes his products offer a solution to problems such as global warming and waste.

Enviro-cements (15 to 90 percent MgO, 85 to 10 percent OPC) contain similar ratios of MgO and OPC to eco-cements but in non porous concretes, brucite does not carbonate readily and develop less strength. Higher proportions of magnesia are most suited to toxic and hazardous waste immobilisation and when durability is required.

These new materials are not only an enabling technology for robotic construction but will result in far greater sustainability in the built environment.

TecEco binders can themselves continue to be recycled and uniquely utilise wastes for their physical property rather than chemical composition. Because of their extreme durability they have the capacity to permanently immobilise wastes from our technical world harmful if let loose in the global commons.

Besides making much more durable concretes tec-cements that can assimilate wastes result in less net emissions as around 20 to 30 percent less is required per tonne or cubic metre of concrete produced.

Eco-cements are uniquely different to other binders in the system. In porous materials they absorb carbon dioxide to set and gain strength and can therefore potentially sequester large amounts of CO_2 where it will do good as a building material in our built environment. The answer nature has shown us to any waste including too much CO_2 in the atmosphere is to use it.

John Harrison is managing director of TecEco and works on the research and development of eco-cements.