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Natural polymer, zein, for tissue regeneration

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Zein is the major storage protein of corn and comprises 40-50% of total endosperm proteins. Zein has been used as microspheres to delay the release of drugs and to protect the drugs from degradation by pepsin, thus can release the drugs for a long time. Our laboratory has developed zein as a novel and potential biomaterial for tissue engineering. Firstly, a three-dimensional zein porous scaffold was prepared and showed to be suitable for culture of various cell lines and primary cells such as human umbilical vein endothelial cells (HUVECs) and mesebchymal stem cells (MSCs) *in vitro*. The scaffolds are characterized with interconnected pore, controllable pore sizes, especially excellent mechanical properties, which are controllable and suitable to act as bone substitutes. Next, we examined its tissue compatibility in a rabbit subcutaneous implanting model, the histological analysis revealed a good tissue response and degradability. The third, zein porous scaffolds modified with fatty acids have shown great improvement in mechanical properties and also good cell compatibility *in vitro*. Besides, the complex of zein porous scaffold and mesenchymal stem cells (MSCs) could effectively promote the ectopic bone formation in nude mice and the repair of critical-sized bone defects in the rabbit model.

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Benefits of recycled polymers obtained from the paint industry on mechanical properties and durability of concrete structures

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Polymeric virgin latexes such as styrene-butadiene rubber and vinyl acrylic homo- or copolymers are widely used in repair and patching works to increase adhesion and bond strengths of cementitious-based materials to various substrates. These have found particular acceptance in reinforced concrete applications due to their superior resistance to corrosion, chloride ion penetration, as well as oxygen diffusion. Because of economical and environmental considerations, the recycling of waste polymers resulting from the paint industry during concrete production has considerably increased over the last years. In fact, virgin polymers are key ingredients in latex-based paints; these are mixed with the pigment/extender powders and stabilized in water with the addition of thickening and dispersing agents. The paints shelf lives are relatively short (up to one year), generating large amounts of waste materials; in the United States, this is estimated around 16 to 35 million gallons per year, about which 5% to 10% ends up in landfills. Existing literature shows that recycled polymers resulting from waste latex paints enhanced plain (i.e., unreinforced) concrete properties, mainly flexural strength given the high tensile strength of latex films associated with bond improvement at the hydrated paste-aggregate interfacial transition zone. Limited studies investigated the effect of recycled polymers on reinforced concrete properties including the bond stress-slip with embedded steel bars and whether such behavior would be similar to that imparted by virgin polymeric latexes. Around fifty concrete mixtures containing different vinyl acrylic-based polymer concentrations are tested by direct bond and beam-end methods. Test results have shown that the concrete-bar interfacial bond stresses occurring during the elastic region substantially improved with recycled and virgin polymers. At similar polymer-to-cement ratio, concrete incorporating recycled polymers exhibited improved bond properties than mixtures prepared with virgin ones. This was indirectly related to the pigment and extender powders in the waste latex paints, thus reducing porosity and improving denseness of cement paste that strengthen the transition zone adjacent to reinforcing bars. The effect of reducing water-to-cement ratio while adding superplasticizer to compensate the loss in workability and compressive strength was found efficient to increase the ultimate bond strength.

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