



Mònica Ardanuy Raso
monica.ardanuy@upc.edu

Fibres for the reinforcement of cementitious matrix composites

In general, composites are formed by two phases: the continuous phase or matrix and the reinforcement. These materials can be classified depending on the nature of the matrix (polymeric, metallic or ceramic) and that of the reinforcement, the most common example being that in the form of short or long fibres or textile structure.

Although the use of fibre-reinforced composite materials has been common practice in the aircraft and military industry since the 1960s, and has been extended to other sectors like the automotive industry, maritime transportation, sport, etc., their application in the building industry is relatively recent.

In this context, the use of fibres or textile structures for cementitious matrix reinforcement as concrete or mortar allows on the one hand reduced transportation costs, easy installation and a decrease in the building load and on the other offers the possibility of moulding

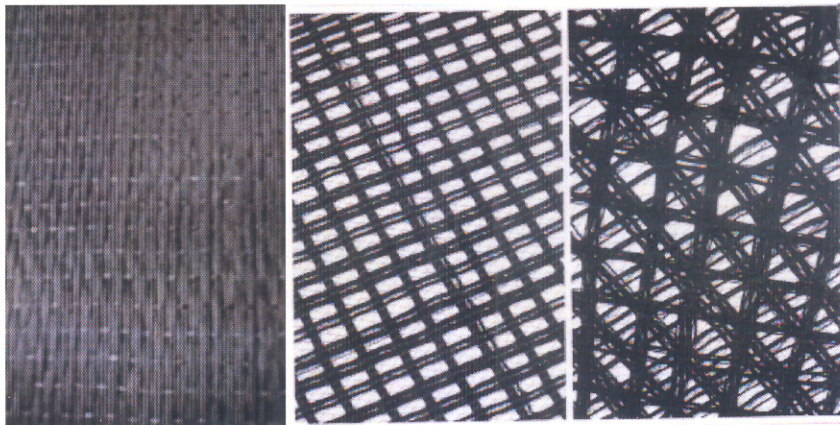
complex shapes in the restoration and renovation of buildings. Moreover, these reinforcements offer composite high resistance to crack propagation, among other advantages.

Among the main fibres used for cementitious matrix reinforcement, the most important are the AR glass (alkali-resistant), carbon and aramide fibres, which have high mechanical and thermal resistance, polyvinylalcohol (PVA) and polypropylene fibres (PP), with high resistance and chemical stability but with low thermal resistance, and the stainless steel fibre traditionally used for the reinforcement of cementitious matrix owing to its high resistance and good adherence with the cementing material.

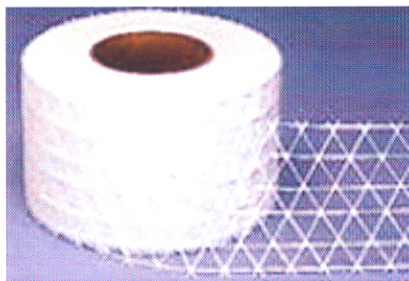
Basically there are two types of fibre-reinforced cementitious composites: those reinforced with short fibre (FRC - fibre reinforced composites) and those reinforced with textile structures (TRC - textile reinforced composites). The FRC

include in their composition short fibres randomly distributed in the mass. The reinforcement will depend on the kind and quantity of fibres used, their geometry and their compatibility with the matrix. As regards the TRC, they are basically reinforced with woven structures and the reinforcement will depend on the kind of fibres used and on the mass and textile structure used. There are on the market a lot of woven structures made with different kinds of fibres which offer high resistance and stiffness and low weight as well as durability and resistance to corrosion.

The weight of the unidirectional fabrics usually varies from 300 to 900g/m² in the case of fabrics made of polymeric or inorganic fibres and is about 2100g/m² for fabrics made of stainless steel fibres. The conventional woven fabrics which offer bidirectional reinforcement are made with a high open structure to reinforce the cementing material. Moreover, there are on the market quadriax-



Unidirectional, biaxial and quadriaxial fabrics for the reinforcement of cementitious composites (Source: <http://www.mapei.es>)



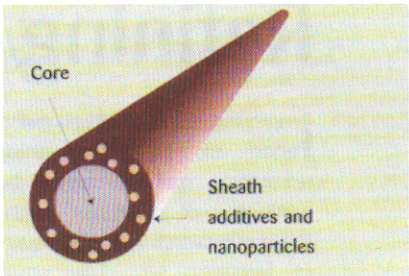
Triaxial fabrics made of PVA (Source: www.jcfa.gr)

ial reinforcements made of high performance carbon fibres for the restoration of concrete structures or heavier ones made of E-glass fibre. On the other hand, are also used as reinforcement ropes with a braided cover and a parallel core made of carbon fibres, which are specially designed to facilitate the structural and functional recovery of monuments and historic buildings damaged over time.

PVA fibres are supplied as chopped fibres as substitute material for asbestos to reinforce cement products or as triaxial mesh for the repair of concrete structures. It is important to note that these fibres are an excellent reinforcement because they have very good affinity with the cementitious matrix and are resistant to alkaline compounds.

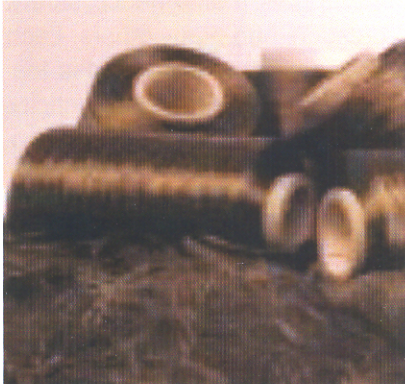
With regard to polypropylene fibres, researchers of the EMPA (Swiss

Federal Laboratories for Materials Testing and Research) have recently developed a bicomponent fibre with a core made of polypropylene (high E-modulus and excellent tensile strength properties) and with a sheath made of a polymer that increases adherence with cement paste. This fibre, specially designed to reinforce the post-crack behaviour of concrete, is as light as an organic polymer and is cheaper than aramides or other fibres like PVA.



Cross-sections of the Concrx fibre (Source: Materials World, Febrero 2010)

Finally it is important to note that, as a consequence of interest in the use of materials provided from renewable resources, reinforcement structures made of natural fibres like basalt fibres (with high thermal and mechanical performance) and cellulosic fibres of high performance like linen or flax have shown an important increase on the market.



Fabric and multifilament yarns for the reinforcement of cementing materials made of basalt fibres (Source: www.fidiaglobalservice.com)