LaMaCo™ Nylon Fiber Multimesh

To Control Early Age Cracking

Introduction:

Nylon Fiber Multimesh fibres are made from nylon and are therefore stronger and bond better into concrete than other synthetic fibres. It has always been recognised that nylon fibres outperform other synthetic fibres but it is only in recent years that manufacturing costs have reduced to make them more economical as well. The main application for synthetic fibres is to eliminate early age cracking and any resultant long-term problems. Secondary benefits are increased impact resistance, reduce bleed and improved build in shotcrete. At high dosages, post crack strength (toughness) can be sufficient to enable replacement of light reinforcement. There can also be minor improvement in concrete properties affected by the improved rheology, for example surface durability.

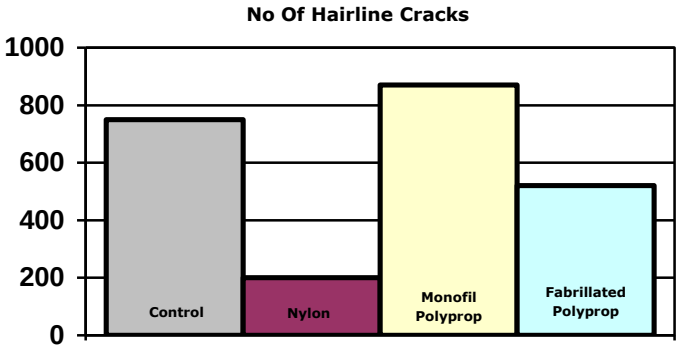
Performance Factors:

Nylon Fiber Multimesh nylon fibre characteristics are particularly suited to control of early age plastic cracking.

- **Fibre Count.** Nylon Fiber Multimesh fibres have a high fibre count due to their low diameter. Millions of fibres are dispersed in each cubic metre of concrete. This means more surface area to bond to the concrete and less distance between fibres for unhindered crack propagation.
- **Chemical Bonding.** Nylon absorbs a small amount of water promoting a chemical bond (with polypropylene the bond is only mechanical requiring the use of fibrillated fibres for optimum performance).
- **Mechanical Bond.** Nylon Fiber Multimesh nylon fibres have enlarged ends providing a degree of mechanical bonding.

Independent testing confirms Nylon Fiber Multimesh's superior performance in reducing plastic shrinkage cracking. Figure 1 shows the cracking in slabs subject to a drying environment.

Figure 1-Performance comparison of fibres (Balaguru)



Early Age Cracking:

Early age cracking (up to 1 day from placement) includes plastic shrinkage, plastic settlement and thermal (heat of hydration) cracking. The concrete has gained little strength as this point and minor stress is sufficient to cause cracking. Synthetic fibres have sufficient strength and the elongation of the fibre at this low stress level is sufficiently small, that they can hold the concrete together. As the concrete develops strength, the fibres become redundant (at normal dosages) as they would elongate significantly (i.e. cracks would become unacceptably wide) before taking the load shed by the "failing" concrete.
Hence, crack control at later ages is normally taken by reinforcing bars. However, it can also be handled satisfactorily by steel fibres (depends on fibre type and loading) and in some cases by high dosages of synthetic fibres.

- **Plastic shrinkage cracks**. When concrete is fresh and green, surface moisture loss in hot and dry weather will cause the young weak concrete to crack from the surface.
- **Plastic settlement cracking** forms when concrete tries to settle after loss of bleed water but is restrained by the reinforcement or other inserts.
- **Thermal cracking** occurs when restrained concrete cools down after expanding due to the heat of hydration.

Drying Shrinkage Cracking: After concrete is set (hardened) and starts to gain strength, the nature of concrete means it wants to shrink further, inducing tensile stress if the concrete is restrained. This shrinkage, coupled with tensile stresses from temperature variation, means cracks will form if the tensile stress is higher than the concrete's tensile strength.
Traditional mesh reinforcement does not stop or reduce concrete shrinkage cracking. It will hold the concrete together and dowel it against vertical displacement when it cracks. Synthetic fibres will behave similarly at high dosages but are of little benefit at normal dosages.
Reduced early age plastic shrinkage cracking, as a result of using synthetic fibres, also means a reduction of weak spots for formation of drying shrinkage cracks.

Fibre Properties: **Nylon Fiber Multimesh** fibre is 100% pure virgin nylon 6 fibre, supplied as a filamentized fibre bundle. Its ability to absorb about 4% moisture (i.e. 25ml of water per cubic metre of concrete at recommended dosage) gives an enhanced bond to the concrete matrix.
The high bonding capacity and high strength enables Nylon Fiber Multimesh fibres to be produced as a fine fibre with 76 million fibres per kg, exposing high bonding surface.
The absorbed moisture readily takes up the colour of matrix. This and the non hairy finish accounts for why it is used by major patterned concrete flooring applicators.
The following table lists some general properties of Nylon Fiber Multimesh fibres.

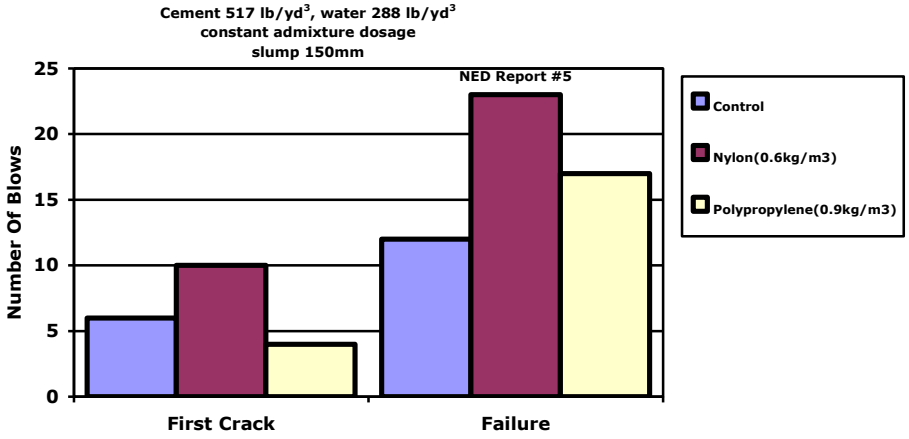
Concrete Properties: The major benefits of using Nylon Fiber Multimesh nylon fibres are:

Property	Multimesh
Tensile Strength	303MPa
Young's modulus	1.57 GPa
Filament diameter	36 micron
Melting point	225°C
Thermal Conductivity	Low
Electrical Conductivity	Low
Alkalinity Resistance	Excellent
Ultraviolet resistance	Excellent

- Guaranteed non-hairy finish
- Better control of plastic shrinkage cracking
- Savings on materials and labour.
- Better colour take-up from the concrete matrix.

Secondary benefits of using Nylon Fiber Multimesh fibre:
- Improved impact resistance (fig 2)
- Improved tensile strength
- Improved bond strength of concrete to steel
- Improved fatigue resistance
- Reduced permeability
- Reduced shotcrete rebound

Figure 2-Impact Resistance



Nylon Fiber Multimesh fibres improvement in concrete performance is shown below:-

Property	Improved Result
Impact Resistance	100%
Compressive strength	12%
Splitting tensile strength	8%
Flexural strength	3%

Method of Use:

Mixing

Nylon Fiber Multimesh fibres can be added to the concrete at any stage of mixing. No special mixing instructions or procedures are required.
Nylon Fiber Multimesh fibres are packed in environmentally friendly degradable bags. These bags can be added directly to the concrete during mixing, resulting in excellent fibre distribution.
If it is added to the concrete agitator on site, three (3) minutes mixing is required.

Packing Size

- 0.6kg degradable bag for reinforcing 1m³ concrete.

Nylon Fiber Multimesh fibres are sold in three lengths:-

- 38mm for concrete
- 19mm for concrete
- 6mm for mortar

Workability

A small slump loss is expected with addition of any synthetic fibres including Nylon Fiber Multimesh.
However, the mix will flow easily under vibration. If slump is to be retained, a water reducer is highly recommended. Adding extra water is discouraged as it will only increase the risk of cracking.

Availability

Nylon Fiber Multimesh fibre is readily available through LaMaCo System Sdn Bhd office below.

Applications:

Nylon fibres have been successfully used for the following applications:-

- Concrete slabs on grade. Nylon Fiber Multimesh fibres are particularly useful to replace the mesh in the slab where reinforced ribs are part of the design
- Precast units to replace light reinforcement, particularly where cover is an issue e.g. kerb blocks and soak wells
- Concrete kerbs to prevent cracking in long thin sections
- Road barriers for impact resistance
- Shotcrete to help cohesion, reduce rebound and control shrinkage cracking
- Repair mortars and renders to improve build and control cracking
- Toppings to control cracking and replace mesh reinforcement
- Oil well cement grouts to reduce bleed and reduce help make crack free gas tight seals
- Patterned paving for a non hairy finish with fibres that take up the concrete colour

LaMaCo System Sdn Bhd

407, Jalan Perusahaan 6, Taman Bandar Baru Mergong, 05150 Alor Setar, Kedah. Malaysia

Tel : +60-4-771 1111 Fax : +60-4-772 4444

Http : www.lamaco.com Email : info@lamaco.com