Technical Data Sheet

Elasto Plastic Concrete

Report on the durability of BarChip structural fibre in a cementitious environment.

BarChip fibre is manufactured from modified virgin polyolefins which are highly resistant to solvents and chemicals.

To confirm BarChip's resistance to alkalis, particularly cementitious environments, durability testing commenced in April 2004 with the preliminary tests being completed in October 2004. These results are reported below.

Testing was undertaken to determine how the fibre's characteristics of tensile strength and elongation are affected by an alkaline environment similar to that of concrete. This was done by subjecting fibre samples to accelerated testing based on Arrhenius Theory (see below).

The durability data presented here is based on testing undertaken at independent laboratories at the industrial Technology Center of Okayama Prefecture (Okayama City) in Japan.

Test Method

BarChip's resistance to attack is based on its permeation resistance to its environment and the rate and extent to which absorption occurs. This in turn affects the suitability of BarChip to serve in a particular environment.

Unstressed samples of BarChip fibre were cast into cement paste prisms.

After hardening these prisms were then immersed in water at a temperature of 60 degrees.

At the required interval the prisms were removed from the water and tested. Ten (10) prisms were tested at each interval and the average of the results used.

***Photo 1**: BarChip fibre cast in cement*

***Photo 2**: Tensile testing of a BarChip strand*

***Photo 3**: BarChip fibre strand after testing*

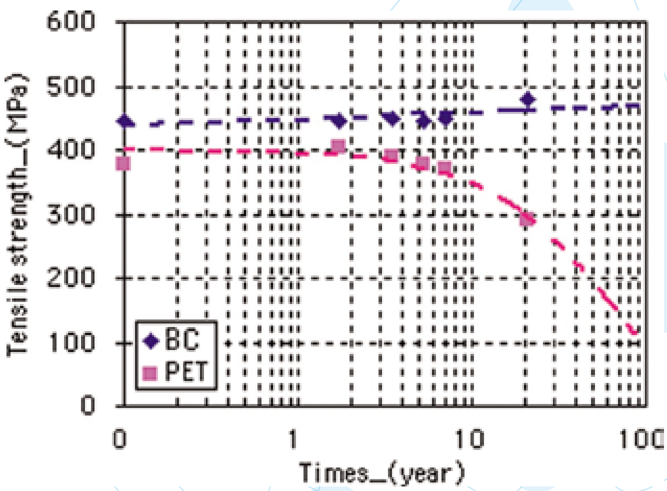
By accelerating the testing it is possible to simulate the performance of BarChip in the future years. The testing gave the duration in years where 1 day = 90 days* equivalent at 60 degrees alkaline environment.

A control of Polyethylene Terephthalate (PET) plastic fibre was also tested.

Results

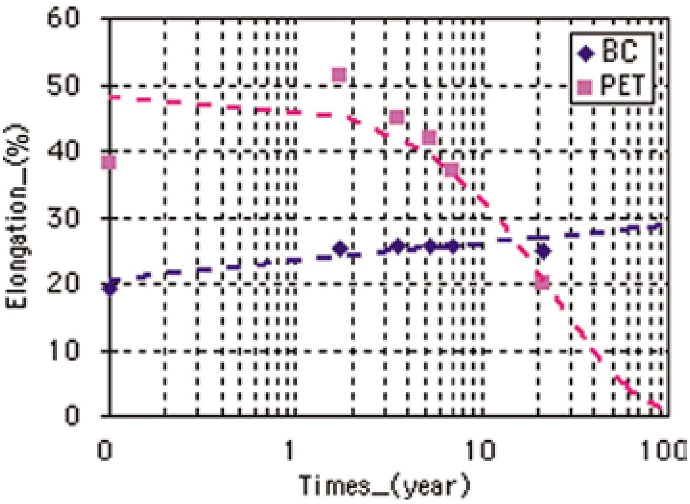
Below are the results of accelerated testing on BarChip fibre and its affect on tensile strength and elongation.

***Fig 1** shows the affect of alkalis on BarChip's tensile strength over 100 years.*



Days	0.1	7	14	21	28	84
Year*	0.1	2	4	5	7	21
BC (MPa)	446	445	449	447	448	480
PET (MPa)	378	402	390	377	368	292

***Fig 2** shows the affect of alkalis on BarChip's elongation over 100 years.*



Days	0.1	7	14	21	28	84
Year*	0.1	2	4	5	7	21
BC (%)	19.23	25.43	25.84	25.75	25.5	24.8
PET (%)	37.94	51.25	44.95	41.86	37.15	20.0

The current data is equivalent to approximately 21 years of natural life in an alkaline environment such as concrete. The results have been extrapolated from 21 – 100 years based on the data to date.

Conclusion

The testing shows that BarChip offers outstanding resistance to a cementitious environment.

Based on these preliminary results testing commenced in January 2005 to verify the durability performance of BarChip fibre up to 100 years in an alkaline environment.

***Reference:** Pro-fax and Moplen Polypropylene Chemical Resistance - Basell Polyolefins August 2002 (www.basell.com).*

Arrhenius Theory

In 1889, Svante Arrhenius noted that reaction rates could be understood to depend on activation energy Ea and T (in kelvins) with the exponential form k = A exp(-Ea/RT) where the rate constant k is the total frequency of collisions exp(-Ea/RT) that have an energy that exceeds a threshold activation energy Ea at a temperature of T.T is

Thus it is shown that increases in temperature increase the fraction of molecules that have the activation energy (Ea). Therefore by increasing the temperature it accelerated the reaction and simulates a longer duration.

Further Reading

An 18 year test program has been completed on the tensile stress-strain performance of cement in composites reinforced with two types of polypropylene fibrillated networks. Three storage conditions were used – natural weathering, storage inside laboratory air, and underwater storage. Some composites were pre-cracked before exposure and others left uncracked before testing. The parameters measured included the elastic modulus and cracking stress of the matrix, complete tensile stress-strain curves and crack distribution in the composite, and the effects of the different weathering conditions on the tensile strength, strain to failure and bond strength of the polypropylene reinforcement.

It was shown that the strength, ductility and toughness of the composite was maintained regardless of exposure conditions for very long periods of time giving increased confidence in the long term stability of polypropylene in a cementitious environment.

"The effects of age up to age 18 years under various exposure conditions on the tensile properties of a polypropylene fibre reinforced cement composites"
D.J. Hannant University of Surrey Guildford 1998 Materials and Structures Vol 32 March 1999 pp 83-88.

Okayama Prefectural Testing Institutes

Okayama Prefecture in Japan has a number of testing institutes which offer state of the art research and development.

These testing laboratories and research centres include: Industrial Technology Centre of Okayama Prefecture, the Okayama Ceramics Centre, and the Research Institute for Biological Sciences, Okayama. These groups conduct cutting edge joint research with universities in Japan and other countries as well as private corporations in mining and manufacturing industries, high temperature composite materials, biotechnology, and other fields.

EPC Australia	call +61 1300 131 158	email australia@elastoplastic.com
EPC Europe	call +44 (0) 77 8070 2642	email europe@elastoplastic.com
EPC Asia	call +65 6835 7716	email asia@elastoplastic.com
EPC N. America	call +1 704 843 8401	email na@elastoplastic.com
EPC S. America	call +56 32 271 5118	email sa@elastoplastic.com

Distributors are located in other regions. For contact details speak to your nearest regional office listed above.