

Improved corrosion resistance of brake pads by using Roxul®1000 fibres



INTRODUCTION

Roxul®1000 fibres are widely used as a reinforcement product for friction materials. In all kinds of non-asbestos applications they are an important component of new generations of formulations.

Roxul®1000 fibres primarily offer high temperature reinforcement to friction materials preventing the materials from e.g cracking during heavy duty driving conditions.

Besides pad failure due to thermal damage, brake pads can also be mechanically damaged when they are exposed to a corrosive environment. This can especially be the case in winter time when salt is used to prevent roads from freezing. The salty water in combination with atmospheric moisture forms an aggressive environment. This environment can cause brake pad failure like edge crumbling and detachment of the friction material from the back plate. Both are not acceptable. Even in the absence of salt, hot and humid conditions can cause corrosive damage to a brake system and brake pads specifically.



Figure 1. Pictures of detachment of friction material from the backplate and edge crumbling.

This leaflet describes the results of an evaluation of the impact of different mineral fibres on the corrosion resistance of brake pads.

EVALUATED FIBRES

The performance of Roxul®1000 was compared to slag wool and Alkaline Earth Silicate (AES) fibres, which are also called bio-soluble ceramic fibres. Table 1 shows the fibre dimensions of the three evaluated fibres:

Fibre type	Weighted fibre length [µm]	Numerical fibre diameter [µm]	Shot >125 µm [%]
Low shot Roxul®1000	150	5,5	0,1
Low shot slagwool	155	4,9	1,4
Low shot AES fibres	155	5,0	1,1

Table 1. Overview properties used fibres.

RESEARCH SET-UP

The research has been performed in two steps. First the corrosion resistance of the fibres has been evaluated in a two-component formulation with resin. Second the corrosion resistance has been evaluated in a commercial NAO/non-steel passenger car disc pad formulation.

TWO-COMPONENT FORMULATION

Table 2 shows the evaluated two component formulations:

Fibre type	Low shot Roxul®1000 [vol%]	Low shot slag wool [vol%]	Low shot AES [vol%]
Phenolic resin	23	23	23
Fibre	77	77	77

Table 2. Two component formulations

For all formulations this equals 12 weight% resin and 88 weight% fibres.

The formulations were dry mixed in a high intensity mixer and hot moulded at 160°C and 175 kg/cm² for 6 minutes and cured for three hours at 200°C.

COMMERCIAL NAO/NON-STEEL FORMULATION

Table 3 shows the evaluated commercial NAO/non-steel passenger car pad formulations:

Fibre type	Low shot Roxul®1000 [vol%]	Low shot slag wool [vol%]	Filler (BaSO ₄) [vol%]
Resin & cashew dust	24	24	24
Rubber crumb	4	4	4
Aramid	6	6	6
Mineral fibre	9	9	-
Potassium titanate	15	15	15
Lubricants	6	6	6
Abrasives	10	10	10
Non-ferrous metals	3	3	3
Fillers	23	23	32

Table 3. Commercial NAO/non-steel passenger car pad formulations.

The formulations were dry mixed in a high intensity mixer and hot moulded at 160°C and 300 kg/cm² for 6 minutes and cured for three hours at 200°C.

CORROSION TEST SCHEDULE

The following test schedule has been followed for all corrosion tests:

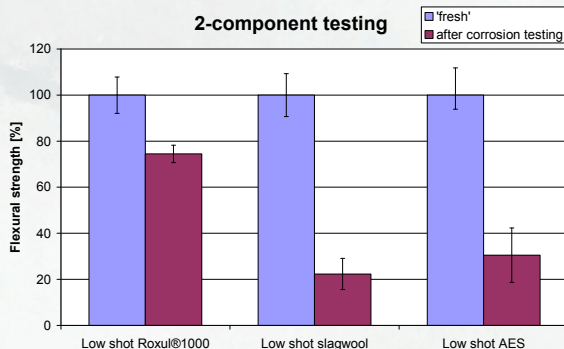
1. Immerse pads in a 5% salt (NaCl) solution (pH 7,5) for 30 minutes
2. Place pads on a rotor and put them in climate chamber for one week at 35°C and 90% humidity
3. Take pads from rotor and repeat procedure (steps 1-2) three more times leading to a total corrosion time of four weeks.
4. Determine mechanical properties of pads (flexural strength) before and after corrosion testing.



RESULTS

The mechanical properties of the materials were determined by measuring the flexural strength both before and after corrosion testing.

TWO-COMPONENT FORMULATION

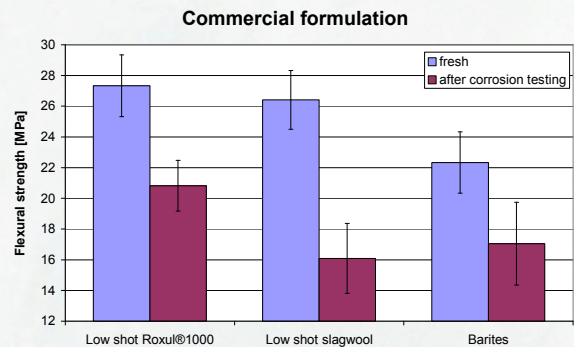


Graph 1. Flexural strength results 2-component formulation.

The graph demonstrates very clearly that the Roxul®1000 fibres are much better in keeping their reinforcement properties compared to slag wool and AES fibres, which both almost completely lose their reinforcement properties.

When evaluating a filler (BaSO₄) in this 2-component formulation a decrease in flexural strength of ±25% was observed, same as for Roxul®1000 fibres. This indicates that the loss in strength of the formulation with the Roxul®1000 fibres is not due to fibre degradation, but due to resin degradation and/or loss in resin bonding.

COMMERCIAL FORMULATION



Graph 2. Flex. strength results commercial formulation.

This graph demonstrates that the Roxul®1000 fibres both before and after corrosion testing offer approximately 25% additional reinforcement to the friction material compared to a filler. The slag wool on the other hand also offers 25% additional reinforcement before corrosion testing, but loses all its reinforcement properties after corrosion testing. This is in line with the results of the 2-component testing. Also for the AES fibres, based on the 2-component test results, it can be expected that they do not offer any significant reinforcement to the friction material anymore after corrosion testing.

CONCLUSIONS

In general mineral fibres can be very sensitive for a loss in mechanical properties under corrosive conditions. Roxul®1000 fibres however show an excellent resistance to corrosive conditions, keeping their reinforcement properties. This results in a stable performance in the brake pads during the life time on a vehicle.

Slag wool and probably also AES fibres on the other hand are very sensitive for the loss in mechanical properties under corrosive conditions. During the lifetime of a pad this can e.g. lead to increased edge crumbling and cracking, increased wear and increased NVH.

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