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The impact of wear on mechanical properties of roving

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Abstract. The paper deals with the influence of mechanical wear out on the resulting mechanical properties of roving. The paper deals with the scraping of roving from inorganic fibres. Glass, carbon and basalt roving are used for this experiment. Rovings are mainly used for the production of composites. The preparation of the roving for processing into composites includes their coiling of the supplied large coils on the coils used in the manufacture. With this rewinding, mechanical damage to roving can occur, which could result in loss of strength. The aim of this work is to determine whether the values of the mechanical properties change depending on the wound generated during winding.
For this purpose, a special Cycle Abrasion Apparatus has been developed to simulate wiping during winding. The work is first aimed at finding the optimal measurement procedure on the Abrasion Apparatus. Further, the results of weight loss, loss of strength, particle removal and measurements on the Zweigle G522 instrument are processed.

1. Introduction

1.1 Description of used material

It was focused on carbon-fibre, basalt and glass (GF-glass fibres) in the form of roving, which are mainly used in the production of composites. The mechanical properties of several types of fibres from different manufacturers were selected and tested. These are in particular carbon fibres from four different manufacturers, glass fibres and basalt fibres. Description of used fibres you can see on table 1.

Table 1. Sample of rovings

Material	Type	Number of fibril	Fineness [tex]
Glass 907	Glass-E PR 440	16 K	2400
Glass 908	Glass-E PR 440	16 K	1200
Carbon	E HTS40 F13	24 K	1600
Carbon	J STS40 F13	24 K	1600

1.2 Measurement description Apparatus

For measurement of roving we have specially built an abrasive equipment. It consists of a pulley and a large wheel that are powered by a motorcycle. It also has two pulleys that are firmly attached. The fibres are guided over the wheel and between the pulleys. After abrasion, roving was captured in frames and subjected to a tearing test.

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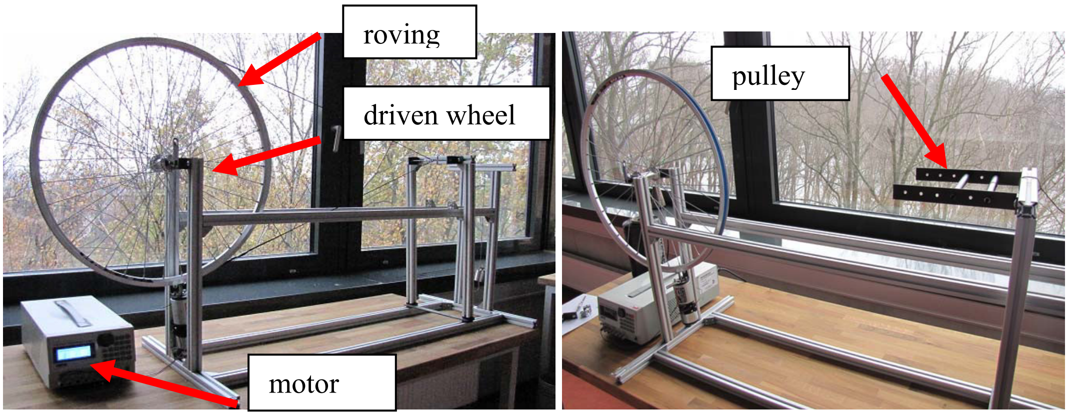

Figure 1. Apparatus for simulation of wear of roving

1.3 Measurement description Zweigle G522

The planes were scraped off by roller-coated sandpaper, which rotated when moving, see figure 2. The roller travelled in a certain section under roving back and forth, that is, in the cycle. Due to the wicking of the separated tear-off fibres on the roller, the abrasion to the entire roving layout was not possible and only cycling was selected.

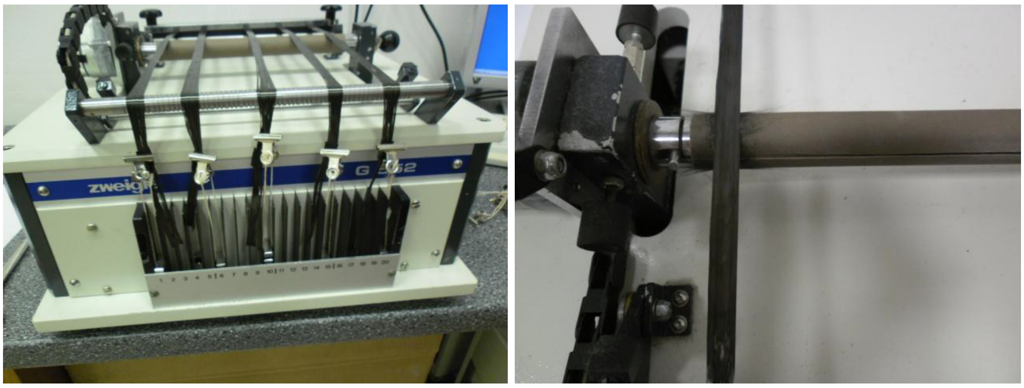

Figure 2. Zweigle G 522 with carbon roving

2. Experiment

2.1 Results of measurement after simulation on Apparatus

Simulation was done in 50 cycles. Abrasions samples was use for testing of mechanical properties. Each sample were fixed with glue to paper frame for simple manipulation. Measurement was make for 10 sample of each type of testing sample.

Table 2. Weight decrease [‰] of glass and carbon samples after using apparatus for wears simulation

Speed of simulation [m.s^{-1}]	Glass 907	Glass 908	Carbon E	Carbon J
0,7	0,07	0,34	0,19	0,19
1,4	0,18	0,54	0,35	0,28
2,1	0,22	0,21	0,28	0,58

Table 3. Average length/ minimal length [mm] of glass and carbon samples after using apparatus for wears simulation

Speed of simulation [m.s^{-1}]	Glass 907	Glass 908	Carbon E	Carbon J
0,7	8,4/1	3,6/2	14,6/1	17,8/1
1,4	5,5/1	6,3/1	14,4/1	11,6/1
2,1	4,7/2	11,3/2	11,5/1	14,7/1

Table 4. Strenght [N] of glass and carbon samples after using apparatus for wears simulation

Speed of simulation [m.s^{-1}]	Glass 907	Glass 908	Carbon E	Carbon J
without simulation (“raw”)	1476,4	735,8	1900,9	1596,7
0,7	1425,3	669,1	1999,3	1733,1
1,4	1431,6	716,6	2026,5	1784,9
2,1	1392,1	718,0	2005,6	1746,0

Table 5. Elongation [%] of glass and carbon samples after using apparatus for wears simulation

Speed of simulation [m.s^{-1}]	Glass 907	Glass 908	Carbon E	Carbon J
without simulation (“raw”)	3,0	2,8	1,8	1,8
0,7	3,3	2,9	2,1	1,9
1,4	3,3	3,0	2,0	1,9
2,1	3,3	3,1	2,0	1,9

Table 6. Module of elasticity [GPa] of glass and carbon samples after using apparatus for wears simulation

Speed of simulation [m.s^{-1}]	Glass 907	Glass 908	Carbon E	Carbon J
without simulation (“raw”)	51,0	55,5	117,6	100,4
0,7	45,8	48,4	105,6	101,7
1,4	45,6	49,9	111,4	102,3
2,1	43,8	48,5	110,5	103,1

2.2. Results of measurement after simulation on Zweigle G522

Table 7: Strenght [N] of glass and carbon samples after abrasion on Zweigle G522

Number of abrasion	Glass 907	Glass 908	Carbon E	Carbon J
0	1476,4	735,8	1900,9	1596,7
50	-13,4 %	-20,0 %	-3,4 %	-3,3 %
100	-13,8 %	-20,5 %	-5,2 %	-7,4 %

You can see different behaviour due to tensile testing of glass and carbon rovings on figures 3 and 4.

Figure 3. Behaviour of Glass roving in process tensile testing

Figure 4. Behaviour of Carbon roving in process tensile testing

3. Conclusion

As a result of the wicking of individual fracture fibres on the pulleys, there was a greater serious drop in some roving. Part of the measurement was to determine the lengths of the contaminated particles during device measurements. Particle collection was performed in the three most undesired places under the Aparatarium. For the wear of roving, the Apparatus for abrasion proved to be the most suitable way of rubbing.

As results of measurement tensile properties of Glass and Carbon roving shows change which is not so significant. We can suppose: Ordinary damage of rovings, during processing, are not significant for properties of final products.

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