Research on the Polymerization of Binder Adhered to Fibre

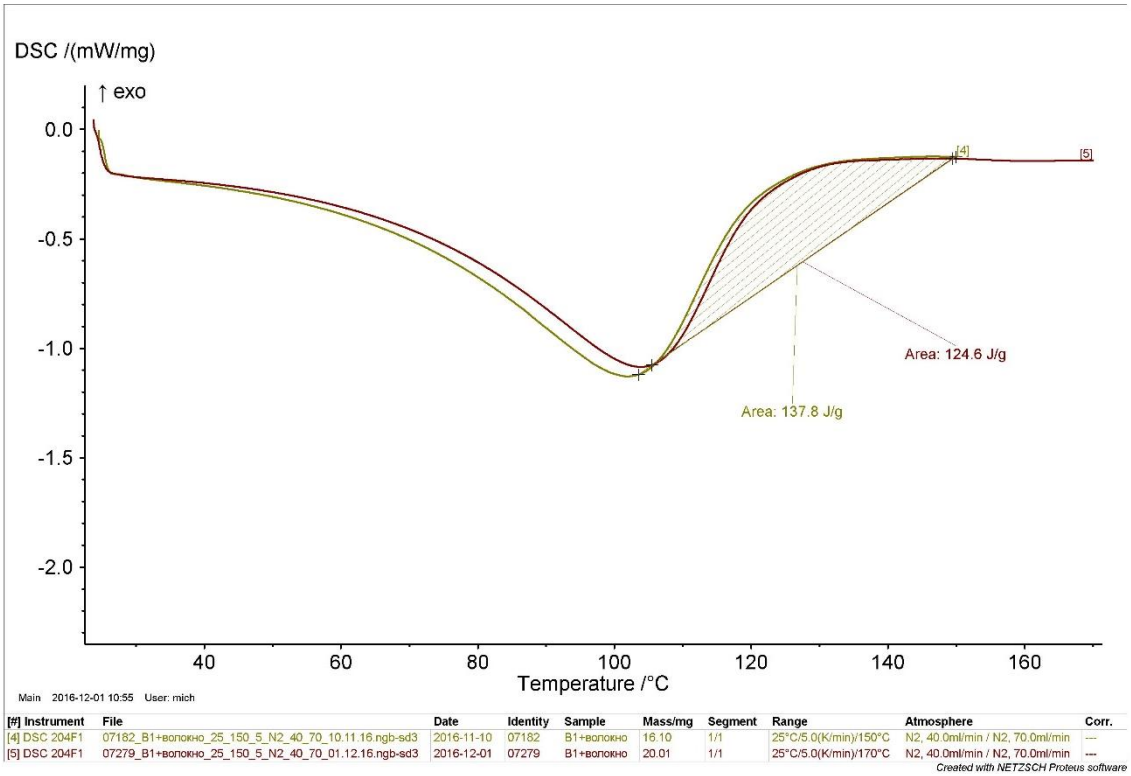
Test procedure (experiment of 01.12.2016).

1. Basalt fibre weighing 18,05 mg was placed into the binder and kept for 5 minutes.
2. Next the fibre was taken out of the binder and pressed out between two hard plates.
3. Subsequently the fibre was put into a spinner to extract residual binder. After extracting the sample weighed 20,01 mg. The weight increment added up to approx. 10%.
4. Fibre with binder was placed into an aluminium furnace, covered with a lid and crimped.
5. A 1-mm-diameter hole was stabbed in the lid.
6. The furnace with the sample was put into a DSC device. The heating rate was 5°/min.

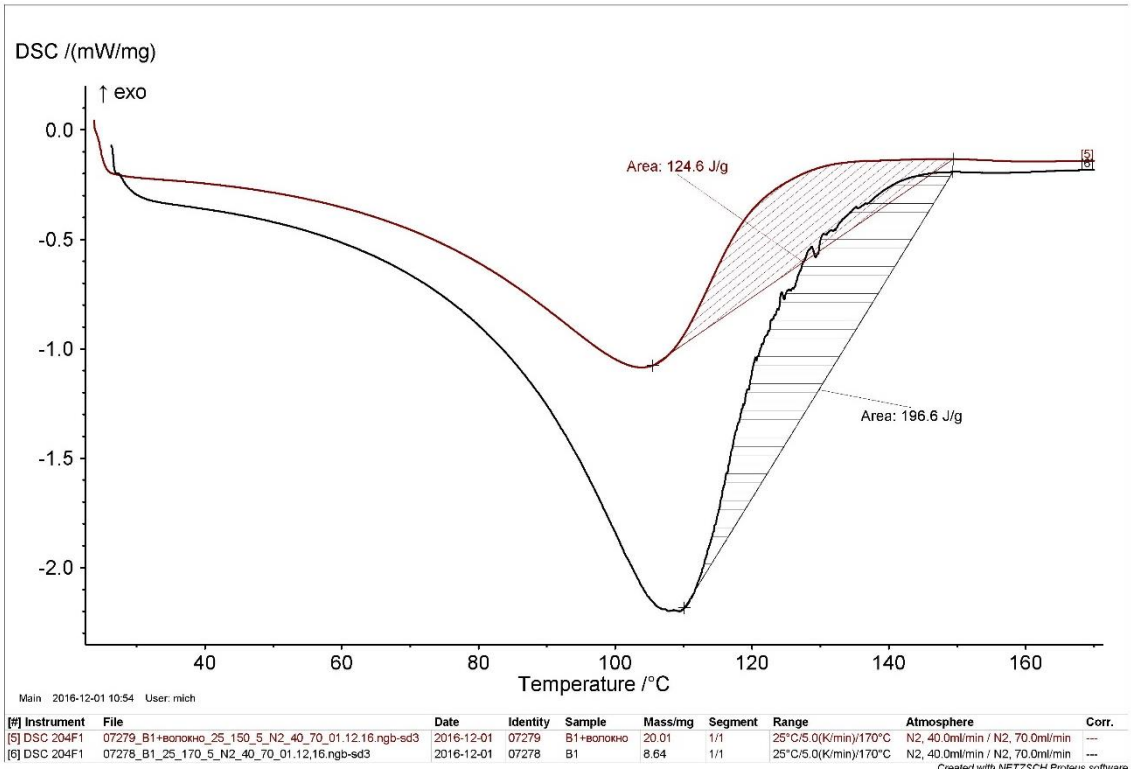
Picture 1 shows the DSC heating curves of the fibre samples with binder. As is seen from Picture 1, the binder samples tested for polymerization on 10.11.2016 respectively on 01.12.2016 are identical. The tested samples demonstrated a binder-related weight increment of approx. 10% (experiment of 01.12.2016) and 11% respectively (experiment of 10.11.2016, weight of sample with binder – 16,1 mg). As demonstrated in the picture, the observable thermal effect of the polymerization corresponds in both experiments within the experimental error and equals to approx. 130 J/g.

It should be noted that at measuring the thermal effect of polymerization, only the observable heat effect can actually be considered. As is seen from the picture, up to approx. 100 °C an endothermic heat effect is prevailing, which is related to the evaporation of binder. Above 100 °C an exothermic heat effect prevails (polymerization). However, both below and above 100°C two effects are indeed appearing: energy absorption and energy release. An indirect evidence of such processes is also provided by the different temperatures of polymerization (ΔT = 5-7°) for the pure binder and the binder on basalt fibre (pic. 2). The different values of the thermal effects for the pure binder and the binder with fibre are as well related to the overlapping of the two effects.

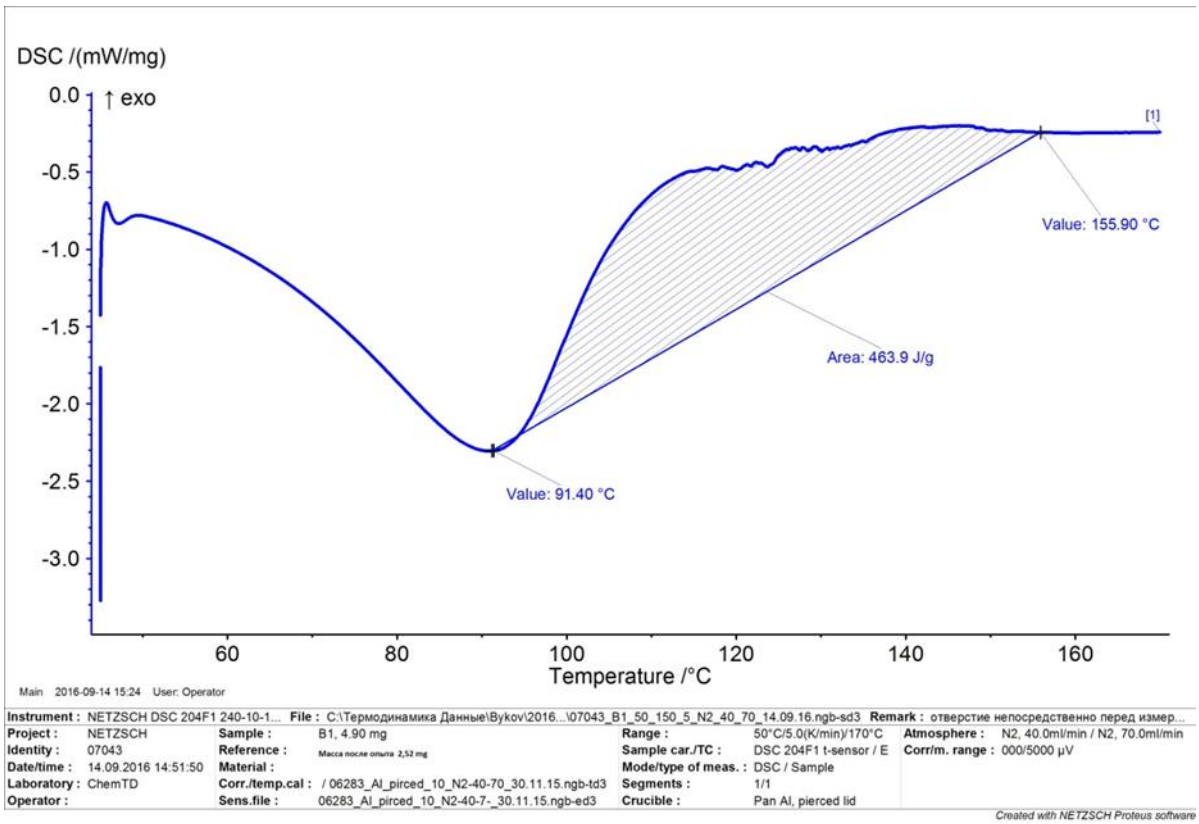
It should also be noted that the binder samples submitted for testing in September respectively November (December) 2016 were different (pic. 3). These binders differ in the temperatures of the polymerization start ($\Delta T \sim 20°$) and thereby in the thermal effect itself. The less binder evaporated before the start of the polymerization, the greater a thermal effect.



Pic. 1. Thermal data of the heating of binder with fibre. The temperature range is between 25^{0}C and 150^{o}C (grey curve, experiment dd. 10.11.20016) resp. 170^{0}C (purple curve, experiment dd. 01.12.2016).



Pic. 2. Thermal data of the heating of pure binder (black curve) and binder with fibre (purple curve). Binder sample of 01.12.2016.



Pic. 3. Thermal data of the heating of pure binder from 25^{0}C up to 170^{0}C (experiment with binder dd. 14.09.2016).