Effect of runner material on ice friction in bobsleigh

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Introduction
In bobsleigh, there is a high interest in knowing the effect of runner material on ice friction due to the high impact of material on runner performance. Frequently, few milliseconds decide between victory and defeat. Thus the individual adjustment of the material to temperature and weather conditions is essential for success.

Methods
A test bench was designed to study ice friction in laboratory tests. The test bench was installed in a cooling chamber, where it was possible to generate temperatures between –2°C and –20°C. A rotating ice disc with a spiral track allowed measuring distances of 240 m length on a continuous fresh and untravelled way. The surface of the ice was prepared with an ice cutter to compare to ice preparation in a bob track. The test conditions were close to the real conditions in a bobsleigh track without any influence of environment. Measurements were carried out at –2°C with velocities of 2 m/s. The samples of each kind of material had a defined area of 32 mm² contacting the prepared ice. Polymer and stainless steel specimen were tested. The sliding surface was polished to a surface roughness of 1 µm. Thus the influence of the sliding surface structure on friction was neglected. The strain gages of the measuring unit were placed in a way, that friction- and normal force were separately measured.

Results
Experiments were conducted with two different specimens of stainless steel and a polymer. During the tests, normal forces between 25 N and 100 N were applied. The friction velocity was 2 m/s and ice temperature was –2°C. Fig. 1 and Fig. 2 show the friction coefficients of the two specimens. Nominal pressure was between 0.8 MPa and 3.2 MPa.

Two main results were derived. The friction coefficient of both specimens on ice decreased with increasing pressure. Additionally, the coefficient of friction of the polymer was lower than the one of stainless steel. Friction values at a pressure of about 1 MPa were 0.0204 for the steel and 0.0144 for the polymer. As an average, a 30% lower friction coefficient of the polymer was found.

Discussion/Conclusion
Results show, that the time saving potential through friction between runner and ice would be about 30%, if the runners were built of a polymer. However, the development of a new bobsleigh runner is limited by a rigorous rules catalogue of the international bobsleigh organisation (FIBT). The runner has to be made of steel, containing at least 50% of iron. Developing and modernising the rules catalogue may be a chance to make the bobsled sport faster and even more interesting.