Diploma-Thesis

Stickiness of silicone rubber in metal moulds

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Summary: Sticking of silicone rubber in metal moulds is a problem in the production of silicone insulators for overhead lines at the firm Pfisterer in Malters. In order to obtain a better knowledge of this sticking process, the following experiments were carried out:
The adhesion properties of silicone rubber on steels containing varying chromium contents were tested. The 180° tensile test was used to test the magnitude of adhesion. It was also thought that the surface roughness of the steels might have an influence on the adhesion; thus tensile testing of silicone on machine-polished and rougher hand-polished steel-surfaces was carried out. Another experiment consisted of testing the influence of internal release agents on the adhesion behaviour of the silicone rubber. Two different types of release agents were tested. In order to have an insight into the change of the silicone rubber's mechanical properties by mixing in release agents, the Young's moduli of the rubbers containing different release agents were calculated. The examination of the wetting behaviour of the steel surfaces was conducted by means of contact angle measurements.
The moulds that are used at the firm Pfisterer for the production of silicone insulators are Teflon-coated. As a possible alternative technique, a sol-gel produced at the School of Engineering in Winterthur was coated onto the steel plates and the adhesion of silicone rubber to it was tested. Contact angle measurements were performed on the sol-gel coating in order to estimate its surface energy. Furthermore, some steel plates were coated by Teflon in order to compare the adhesion properties of silicone onto Teflon with those of silicone onto the sol-gel coating. The surface energy of the Teflon-coating was calculated and compared with the literature.

Results:

- The chromium content did not have a measurable influence on the adhesion.
- The rougher surface polishing led to lower adhesive forces compared with the smoother polishing.
- The internal release agents did not lower the adhesion. They even led to higher adhesive forces.
- The measurements of the contact angles on steels were difficult due to their high surface energy. On the sol-gel coating they were run with succes and led to the surface energy 12.1 $\pm$ 1.2 mJ/m^2.
- The adhesion on the sol-gel coated plates was between 40% and 55% lower than without coating.
- The adhesion on the Teflon-coated plates was more than 60% lower than on the sol-gel coated plates, although the calculated surface energy of this kind of Teflon was higher than that of the sol-gel, namely 17.1 $\pm$ 1.6 mJ/m^2.