Temporal Development of Hot Surfaces in Frictional Steel Contacts in Dependency on the Thermal Conductivity

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1 Abstract

Typical ignition sources for mechanical equipment used in hazardous areas are hot surfaces and mechanically generated sparks. In the friction processes of steel contacts, both ignition sources are coexistent and can ignite explosive atmospheres. Hot surfaces in frictional contacts occur only after a certain contact time. The time until the ignition source becomes effective is largely dependent on the thermal conductivity of the friction partners. The aim of the present research project is to find out the temporal evolution of the formation of ignition sources depending on the relevant structural materials for explosion-proof equipment. With these results, a basis shall be created for predictions by means of computer simulations. Furthermore, the investigations shall be extended to different geometries of the friction partners. The experimental arrangement of the friction-spark forming apparatus is realized via a friction pin which is pressed with constant contact force onto the sliding surface of a rotating friction disc. The tested steels were mild carbon steel and different high-alloyed stainless steels with different thermal conductivities between 15 and 50 W/(m*K). The friction disc is always made of high-alloyed stainless steel, while the material of the pin was varied. Depending on the degree of wear, the test duration takes 30 to 120 s. For detecting the temperature at the wear contact, the pins were prepared with a type K thermocouple in the middle of the friction zone. Another three thermocouples were placed at different heights on the surface. A pyrometer was used to measure the temperature of the ridge which was forced out of the friction zone. The entire friction process with pin and disc was observed with an infrared camera in order to be able to describe the temperature distribution. The experiments were conducted at different velocities of the disc and load per area. The experiments have shown that although the experimental parameters were the same for the different kinds of steel, both the measured maximum temperatures as well as the rate of temperature rise differed. A larger thermal conductivity of the steel used can lead to slower heating of the pin material. With increasing wear rate the maximum temperature decreases.

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