

**(General Motors Corp, 4/19/1996-10/18/2000)**

The investigators were approached by General Motors Corp. to provide assistance with a problem encountered in recycling the metal values from their machining waste, or “swarf”. Swarf consists of finely-divided steel particles with a very high surface area, and when exposed to air these particles undergo significant heating due to oxidation. In extreme cases, the swarf could heat sufficiently to catch fire, which made the material too hazardous to transport to recycling facilities.

A key problem of finding a solution to the self-heating problem was that this behavior could not be replicated in the laboratory, and so it was not possible to carry out laboratory tests to evaluate potential solutions. The investigators therefore first developed a sample collection protocol that preserved the self-heating properties of freshly generated swarf, and then designed a testing method that, for the first time, quantified the heat generated as the swarf oxidized. This testing method was then used to evaluate the effects of a wide variety of surfactant chemicals on the swarf oxidation, as well as the effects of moisture content.

It was determined in the laboratory that the primary effect of surfactants was that they would delay the onset of self-heating behavior, although they did not prevent self-heating altogether. However, this was valuable, as delaying the self-heating would give the opportunity to collect the swarf and isolate it from oxygen. It was also determined that there was a “window” of moisture contents where self-heating could occur. If the swarf was drier than the critical moisture content, there was insufficient water present to catalyze the oxidation and self-heating was much reduced. Alternatively, if the swarf was wetter than the critical moisture content, then oxygen was prevented from reaching the surface of the swarf particles, and again self-heating was reduced.

Based on these laboratory studies, in-plant studies were carried out where freshly-produced swarf was treated using the methods developed in the laboratory. These experiments were successful, and it was possible to develop a protocol that prevented the swarf from self-heating in the plant. This made it practical for the metallic swarf to be sold as metal scrap, so that the considerable metal values that they contained could be safely recovered.