Sherritt Gordon Mines Ltd.

Project director Maurice Clegg (r.) reviews the results of a powder spraying test with Karel Hajmrle (l.) and Tony Chilkowich (c.).

powder forms a low density deposit in which the predominance of graphite (on a volume basis) provides the abradability, and the fine network of metallic nickel provides the integrity necessary for good erosion resistance. Nickel/graphite is a success story in its own right, and is now being used by virtually every major aircraft turbine engine manufacturer in the world for the fan and compressor stages, but it has limitations — its upper temperature limit is 650°C."

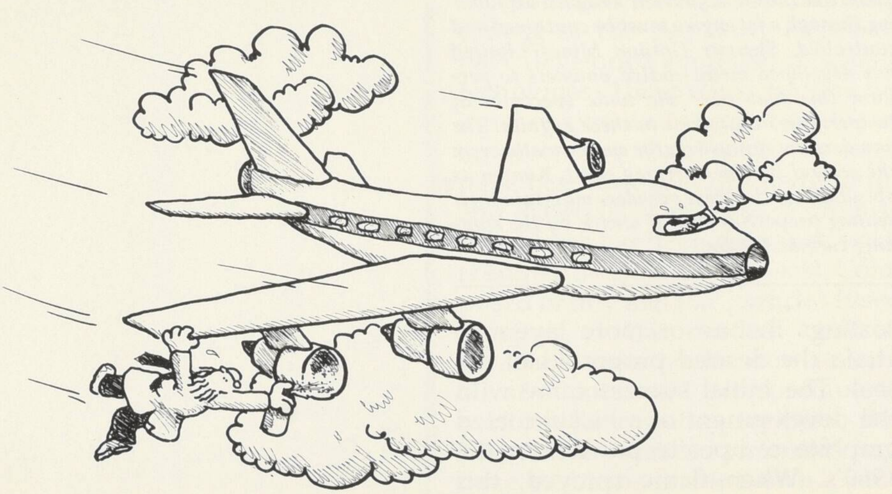
Clegg, manager of Sherritt Gordon's product research at Fort Saskatchewan, Alberta, led a study team of physical metallurgists, chemists, and technicians in the development of high-temperature-resistant composite powders. With support from NRC's Industrial Research Assistance Program, they have worked for the last five years on various core materials and metal coatings for a new line of these powders. "A number of interesting developments arose during the program," he states. "For example, naturally occurring minerals such as Bentonite have been found to be suitable core materials for alloy composite powders used in the production of high-temperature abradable seals. And this led to our first success — a powder that withstood temperatures 250°C higher than anything then on the market."

Part of the Company's program dealt with applying the powders to the engine walls. "The preferred method is flame spraying," Clegg explains. "You have to control the temperature, and the flow rate of the particles into the stream of hot gas must be precise — in fact, all the parameters must combine in such a way that the outer surface of the particle melts just enough to adhere to the engine wall and maintain its own internal adherence without changing the properties of the powder. These powders can now be applied using a labour-saving and much less costly method than previous processes of seal manufacture."

Then there was the problem of moving from the laboratory to actual conditions of application in the engine. "There was very little in the literature on which we could base a comprehensive testing program. No one had determined, for example, what happened to the powders under shear conditions. Did they come apart singly or in groups? Did they harden and create further damage in the engine? After all, the turbine blades are more expensive than the seals. The question of how the coatings eroded in use was basic to the whole program. In a sense, these application tests meant that we were starting the program over from the beginning."

The erosion tests did point out the need for changes in the composition of some of the powders, and this led to the desired properties of hardness, oxidation resistance, temperature characteristics, and abradability. Says Clegg: "Our program also involved upgrading laboratory methods to production techniques and application methods in the shops — always an important step in the development of a new product."

Sherritt Gordon's research produced composite powders stable at temperatures up to 850°C and possessing good thermal insulating properties. This led two major aircraft engine manufacturers to use them on two of their current production engines. An off-shoot of the technology should lead to the use of related powders for other aircraft insulation applications. "These powders are now entering the export market," concludes Clegg. "It's gratifying that IRAP support for Canadian industry helped us achieve these breakthroughs in material and process development."



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