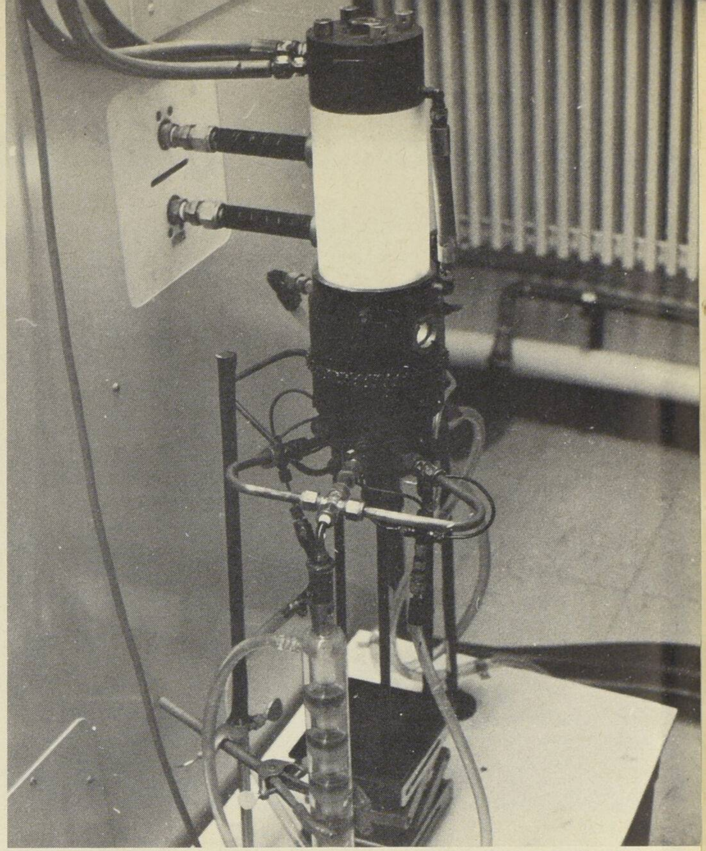

McGILL UNIVERSIT

Plasma torch in operation • Le four à plasma.

their supporting instrumentation were very expensive. But the biggest obstacle of all was that virtually nothing was known about the fundamental aspects of the system (flow patterns, particle trajectories, heat transfer). Without this knowledge, design of the system was impossible.

Since 1962 Dr. Gauvin and his colleagues have systematically attacked each of the basic problems, on the way developing new techniques to probe and measure the characteristics of the inferno with which they were dealing.

"Our systematic approach was born of necessity," says Dr. Gauvin, "since plasma technology in the metallurgical field has progressed rather slowly. Until recently, very little was known about the most basic characteristics of such a system. This is because most of the work in the past has been too empirical or, if theoretical, has dealt with a single aspect of the problem. It was impossible for us to predict how a plasma reactor should be designed for a particular application.

"This plus the complexity of the problem indicated the use of the systems approach. We formed several teams and began to study all factors affecting reactor design. There was no shortage of problems. What would the feed rate of particles into the reactor have to be? What are the velocity and flow patterns of the plasma? How will the particle move in the plasma jet? What is the distribution of temperature in the reactor? What are the characteristics of the transfer of heat from the hot gases to the particles? What is the reaction mechanism and the rate of reaction? The answers taken as a whole should permit the design of a large-scale plasma reactor for treating molybdenum sulphide.

"In fact, modelling studies enabling us to predict the behavior of this particular system by means of computations have now been completed and on the basis of these studies, a small reactor has been built. It will be used to study multi-particle systems under continuous conditions."

For these studies, a new method to measure plasma velocity and turbulence characteristics is being developed under the direction of Dr. J.R. Grace, a member of the Plasma Technology Group. Called a laser doppler anemometer, the instrument is based on the shift in frequency of the light scattered from the laser beam as it passes through the small particles in the plasma. This frequency shift ("Doppler shift") is proportional to the velocity of the gas. The laser doppler anemometer is the first of its kind in Canada and was obtained with the help of the NRC grant.

Another member of the Group, Dr. Roland Clift of the Chemical Engineering Department (in addition to his interest in the fundamental aspects of plasma flow patterns and particle motion) has begun investigations aimed at developing a process for the production of titanium carbide which is used for arc-melting electrodes and as an additive in making cutting tools. Titanium carbide currently costs about $4.00 a pound. Dr Clift's research in this area reflects the Plasma Technology Group's interest in utilizing high temperature processes not only to separate metals from their ores but also to form metal compounds under the resultant high temperature conditions. These compounds — oxides, silicides, nitrides, carbides — could have interesting new properties such as heightened resistance to corrosion or increased effectiveness as semi-conductors.

"The Noranda Research Centre will be conducting development work on the plasma reactor and its use in metal extraction," says Dr. Gauvin. "It is expected that a pilot plant will be installed at the Centre shortly. On the other hand, McGill University will continue to do all the fundamental work on this project.

"We still need more accurate data on heat transfer to particles and on the characteristics in particulate systems. Better information is also required on the plasma flow patterns and their turbulence characteristics, while our model of the system must be constantly refined. On the experimental side, we are attempting to develop and optimize feeding techniques and techniques for separating the vaporized sulphur more effectively, and we are experimenting with other gases besides the argon we now use in the plasma reactor."

The Plasma Group will shortly extend its studies of the application of plasma technology to other metals besides molybdenum, such as tungsten, columbium, tantalum and titanium. In parallel with this, research into new industrial applications for molybdenum is continuing. Besides being an excellent alloying element in steel production, it may form useful alloys with other metals. Salts of molybdenum make excellent high-intensity pigments for the paint industry. They give magnificent oranges, reds and yellows with high covering power. In addition, a white non-toxic corrosion-inhibiting pigment based on zinc molybdate is now available as a replacement for lead-based paints. If molybdenum production costs were reduced, this metal could become quite competitive with nickel in some of the latter's applications.

"The Plasma Technology Group at McGill has existed for a little over two years," points out Dr. Gauvin, "but it has already demonstrated that collaboration between industry and university, when intelligently conducted between people with strong mutual interests, can bring about fairly quick results in areas of economic and social significance to the country, with a relatively modest financial input from the government. The rewards for both sides are great: for the university researcher the intellectual reward of having contributed very significantly to the fundamental knowledge of the basic phenomena underlying a new and exciting high-technology frontier, and for industry, the possibility of establishing brand-new secondary industries which will upgrade the values derived from natural resources." □ Earl Maser