International Research Project Studies

Low Shaft Blast Furnace

THE International Cooperative Research Project on the low-shaft blast furnace is expected to provide metallurgical information on the departure from thermodynamic equilibrium in a rapidly moving burden; redistribution of the various reaction zones in a greater thermal gradient than has been observed heretofore; the effect of various controlled variables on the proportion of direct reduction; the nature and kinetics of desulphurization by silicon disulphide formation; and the nature of intermediate slag-forming reactions.

Because the low-shaft furnace permits the use of high oxygen concentrations, high hearth temperatures can be obtained. Blast furnace operators therefore will be able to learn from the project: 1—if obtainable temperatures and rates of heat exchange are sufficient for the large volumes of slag produced in the reduction of low grade or acid ores; 2—if substantial improvements can be obtained in such a furnace when it is used for the preparation of ferroalloys; 3—if mechanically weaker or leaner fuels than coke can be used successfully in iron making; 4—if high sulphur cokes and silicious ores can be used to produce normal iron under conditions favoring the silicon disulphide reaction; 5—the oxygen concentration of the blast leading to the minimum coke rate; 6—the degree of stability and the degree of flexibility obtainable with oxygen practice; and 7—the rate of production obtainable in a low-shaft furnace.

Data on the behavior of briquetted fuels, ores, or mixtures of ores and fuels will be of considerable interest to the fuel industry. Information on the behavior of the furnace refractories under extreme conditions met in the low-shaft furnace will be important to the refractories industry. The possibility of producing acid slags suitable for cement manufacture also will be investigated.

Of the two low-shaft blast furnaces to be constructed, the one at Liege, Belgium, will have a rectangular cross section, 4x8 ft, with the corners rounded. It will have no inwall batter, and will have at least six adjustable tuyeres distributed along the long sides. The other furnace at Oberhausen, Germany, will be cylindrical and about 6½ ft diam. The height of the furnace will be about 16½ ft, although it was thought that better elimination of sulphur as silicon disulphide would be obtained in a shorter furnace working with a high top-gas temperature. The difficulty in this connection is that the side-hopper top construction contemplated for the furnace does not permit any stockline variation. It was decided to place the desulphurization problems late in the program when further information will be available upon the shaft height question. The furnaces were designed by the firm of Glockner-Humboldt Deutz together with engineers of the firm Ougree-Marihaye and the Centre National de Recherches Metallurgiques.

Among the first trials on the program are those concerned with the preparation of the burden. Since it was decided to experiment with fines and low grade ores and fuels, it will be necessary to prepare the burden into briquettes or other forms of agglomerate. The experiences of the French zinc industry, of the Glockner firm, and of Canadian and American blast furnace operators were reviewed. It was concluded that a considerable part of the research program should be devoted to the development of methods of burden preparation. The results obtained will be applicable also to the preparation of normal blast furnace burdens. The materials to be tried first on the program are Minette ores and either Belgian lean coal or French semi-coke. Wind containing oxygen concentrations up to about 70 pct will be used to determine the optimum enrichment. Top pressure operation is contemplated in a later phase of the project.

The project is being undertaken jointly by Governmental and industrial organizations in several European countries. The contracting parties are: Oesterreichische Alpine Montan Gesellschaft, Vienna, Austria; Institut pour l'Encouragement de la Recherche Scientifique dans l'Industrie et l'Agriculture, Brussels, Belgium; Institut de Recherches de la Siderurgie, St. Germain, France; Ministry of Coordination, Athens, Greece; Associazione Industrie Siderurgiche Italiano, Milan, Italy; Groupement des Industries Siderurgiques Luxembourgeoises, Luxembourg; Nederlandse Centrale Organisatie voor Toegepast Natuurwetenschappelyk Ondersoek, The Hague, Holland. Interested German parties have not yet signed up, but the firm of Oberhausen is proceeding with its share of the project. The British Iron and Steel Institute has contributed a small sum, but will have no patent rights. The contracting parties to which the project is of greatest interest are contributing sums of the order of $150,000. Other participants are contributing from $40,000 to $60,000. Austria is represented by a single firm, which is contributing $6000.