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UTILIZATION OF THE IMPERIAL SMELTING PROCESS[1/]

by

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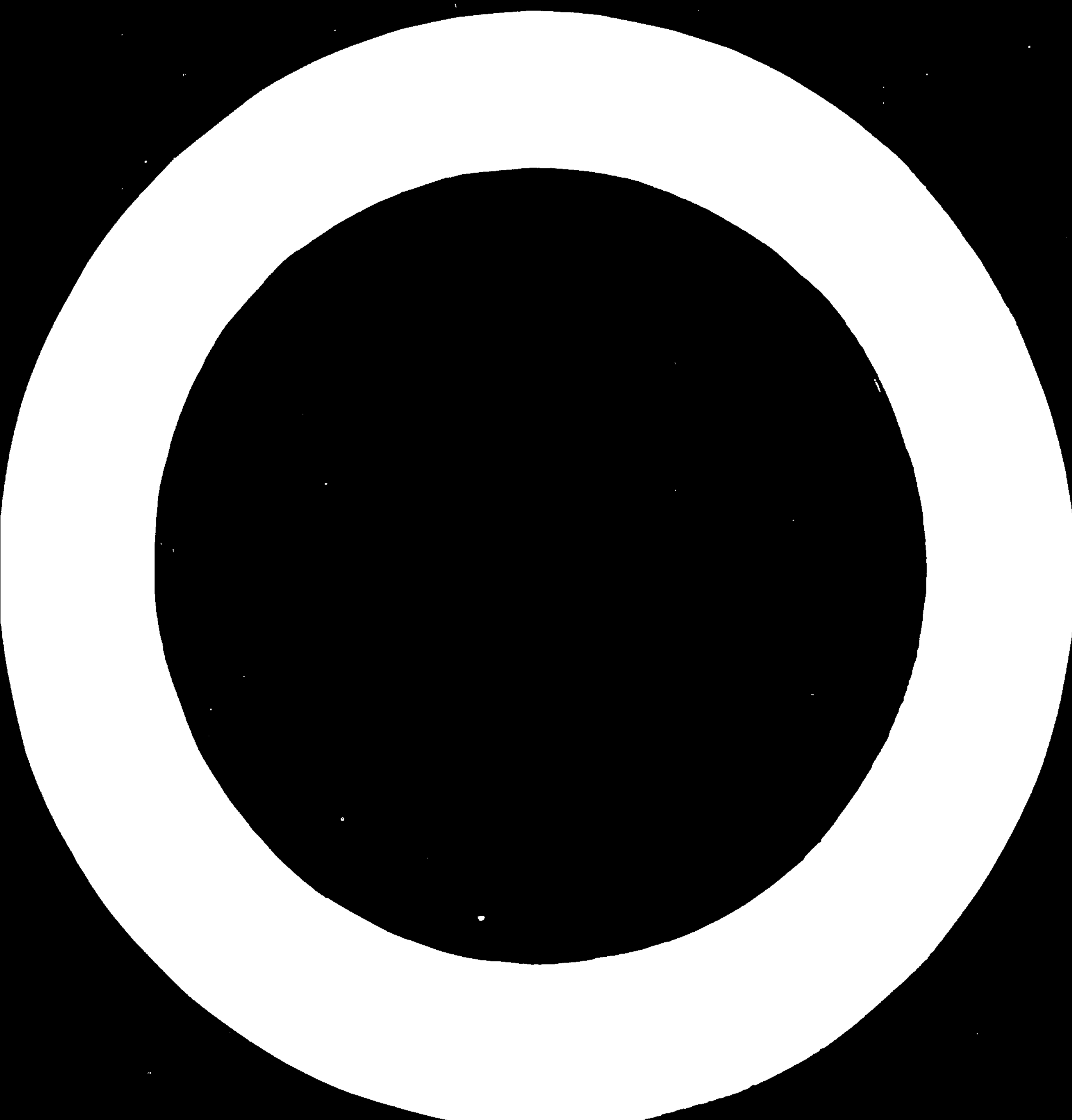

D.A. Temple, in introducing the various papers on the Imperial Smelting Process entitled 'Utilisation of the Imperial Smelting Process' stated that his contribution was aimed at supplementing the papers that had already been submitted to the meeting, including that of Mr. Fujimori of Betu, Japan.

Dr. Temple considered that the present state of application of the zinc-lead blast furnace could usefully be outlined, and he illustrated the location and general characteristics of the 11 units that were currently in operation. (See table attached). During 1968 the I.S.F.'s had contributed about 10% of the total world production of zinc and it was anticipated that by the mid-1970's this would amount to about 25%, along with the simultaneous production of approximately 18% of the world's lead production. It might be worthy of note that around the beginning of May 1969 the process had produced a total quantity of 2,000,000 tons of slab zinc and almost 1,000,000 of lead bullion.

In considering the increase in performance of the standard size of I.S.F. (with a 17.2 M^2 shaft area) constructed at most of the smelter sites, it is interesting to note that the original unit at Swansea was first operated in 1960 to produce 30,000 tons of zinc per year, and the standard I.S.F. unit is now capable of producing 70,000 tons of zinc per year from high grade concentrates. Colleagues at Avonmouth have recently estimated that a further 50% increase is possible in the future. Improvements in smelting efficiencies have also been proposed since 1960, i.e. carbon utilization etc. One important improvement that should be noted is the prolongation of campaign length from fifteen weeks in 1960 to now over two years, due mainly to the development of blasting techniques for removal of accretions from the furnace shaft; the limit of campaign length now depends not on operational or metallurgical aspects but rather on the need to make design improvements or modifications. The I.S.F. is still in a stage of development.

A significant attribute of the process is its flexibility of treatment. S.W.K. Morgan and D.A. Greenwood have defined the metallurgical and economic advantages of increasing the amount of lead that can profitably be smelted; they have shown that as the lead production is increased, the additional lead is produced relatively cheaply and at high recovery. For a high grade charge, the Pb/Zn ratio in sinter is possible up to 0.75/1 The range of charge grade is appreciable. Slag/zinc ratios of between 0.7 and 3.0 : 1 are being operated. The ability of the process to treat increasing amounts of copper has made the I.S.F. into a useful process for smelting copper, which is so often associated with zinc and lead raw materials. As an example, the furnace at Copsa Mica in Rumania regularly produces lead bullion from the furnace hearth containing 9% - 10% Cu, this has been increased to 13%; on special tests at Avonmouth it has been demonstrated that 15% copper and above in molten lead bullion is feasible. Both oxide and sulphide raw materials (either ores or as concentrates may be fed to the sinter machine, in the case of oxide materials, coke fines need to be added as the sintering fuel. With sulphide materials, H_2SO_4 is produced from the sinter plant gases, the amount of H_2SO_4 produced from the complex can be varied according to the variation of the oxide formation of the sinter feed. Thus the I.S.F. can smelt satisfactory sinters made from oxide or sulphide raw materials, and from mixed or bulk Zn - Pb - Cu materials as well as from high grade separate zinc (55% Zn) and lead (70-75% Pb) concentrates.

Regarding the application of zinc and lead smelting in the developing countries, I.S.P. Ltd., considers the minimum size of unit that is economically practical to be a 11 M^2 furnace, especially considering conditions in most countries; however, this is difficult to judge world-wide without making a detailed study. From high grade materials, this size of I.S.F. would produce annually 40,000 tons of zinc and 25,000 to 30,000 tons of lead. Some mention has been made in the earlier discussions of plants to produce 10,000 tons of zinc per year. However, there is a question of the economic viability of an installation of this size. The I.S.F. makes possible a "clear cut" separation of zinc and lead in a single unit, and this results in eliminating additional operations of removing zinc from lead blast furnace slags, by fuming or other methods, and also obviates the recovery of lead and other valuable materials from the leach plant residues formed in an electrolytic zinc plant.

The Imperial Smelting Process must be classified as a sophisticated one, as is indeed true of all modern techniques when one considers the use of automatic handling and control and, more recently, computer control. These tendencies make the process ideally suited to the industrialized countries. It has been shown however, by B. Barlin in his paper at this meeting, that by means of suitable and adequate training, indigenous labour can be employed to operate the process satisfactorily. This tends to contradict the views expressed by J.W. Reimers in his papers. The aspect of training is considered by Imperial Smelting Processes Limited, and by the organizations which operate the process, to be of great importance, and the normal minimum training programme of staff and operators in the United Nations amounts to 7 man-years, involving approximately 24 persons on a carefully planned schedule.

At this juncture it is worthy of note that UNIDO has already played a most useful part in organizing the training of key personnel in the field of non-ferrous extractive metallurgy.

Earlier papers have indicated that the I.S.F. requires a high-grade coke; certainly a good metallurgical coke similar to that suitable for the lead blast furnace must be used. C. Healey defines the grade in more detail. Imperial Smelting Processes Limited have been looking into the use of 'formed coke' made from anthracite and non-coking coals as a fuel for the I.S.F., and the preliminary results are encouraging. Compared with electrical energy generated from water power or other liquid fuels, metallurgical coke, once it has been imported, does not require the supporting capital charges for generation but can be paid for out of working profits once the plant has started operating.

Mention has been made of the opportunity of the I.S.F. to provide better overall recoveries of the metal values; because if one considers the use of separate zinc in lead concentrates, the lead in zinc concentrates and the zinc in lead concentrates, as well as the copper silver in both, are equally recovered at high efficiency. Very often if one considers the overall recovery from ore to saleable metals, the production of both zinc-Pb-Cu concentrates is most favourable for the overall utilization of the metal values. When defining metal recoveries it is necessary to give attention to the grade of raw materials; but e.g. in using the example of high grade concentrates, the following recoveries are possible in the I.S.F.

Zn 92 - 93%
Pb 90 - 96% (depending on the Pb content of the charge).

Massion, Haczek and Adami (3) have reported examples of metals recoveries from the Duisburg I.S.F.

R. Healey in his paper deals with the question of zinc grade as produced directly from the I.S.F. condenser/separation system, as well as with the methods of vacuum dezincing and refluxing toward the production of respectively high-grade and special high-grade metal.

The capital cost of installing a complete I.S.F. plant can best be summarized as follows:

Slb. Zinc	70,000 tons per year (including 35,000 tons special high-grade zinc)
Lead bullion	40,000 tons per year
Sulphuric acid	120,000 tons per year
Cadmium	100 - 200 tons per annum
Copper in bullion	4,000 tons per annum

The figure US$. 375 quoted above assumes a green field site, and includes the I.S.F. and following auxiliary plants: sinter-plant, acid plant, zinc refluxer, pyrometallurgical lead refinery to recover all values, cadmium plant, effluent-treatment plant, ore storage, offices, workshops, laboratories transport, as well as general site development, but does not include working capital. This indicative price factor in US$ has been converted from £s by using a factor of 2.4 and is based on U.K. conditions in January 1969. Naturally the size of I.S.F. and its auxiliary plant, as well as the site location, will effect modifications to this price factor.

An important factor that has emerged from the plants which use the process, is the highly useful aspect of collaboration of members of the 'I.S.F. Club'. Regular exchanges of data and ideas on operating techniques and design components, as well as metallurgical data, is being enthusiastically carried out. Other activities are visits of personnel to each others plants, as well as periodic visits by the technical staff of I.S.P.Ltd. Conferences of licenses are arranged at approximately 3-year intervals. Process development is now based on a co-ordinated programme, making a greatly accelerated progress possible. All these elements of collaboration have resulted in the appreciable development in the process which has taken place and is likely to do so in the future.

THE IMPERIAL SMELTING PROCESS

Continent	Company	Year of Commissioning	Shaft Area (m²)	No. of Condensers	Typical Sinter Composition (%)		10³ Metals Production (... Per Year)	
					Zinc	Lead	Slab Zinc	Lead Bullion
AUSTRALASIA Cockle Creek New South Wales Australia	Sulphide Corporation Pty. Ltd., (Conzinc Rio Tinto of Australia Limited)	1961	17.2	1	45	20	[illegible]	[illegible]
ASIA Befu Japan	Sumiko I.S.P. Co. Ltd., (Sumitomo Metal Mining Co.)	1966	15.3	1	46	19	49	18
Hachinohe Japan	Hachinohe Smelting Co. Ltd., (Japanese Smelters Consortium)	1969	17.2	1	42	20	–	–
AFRICA Kabwe Zambia	Zambia Broken Hill Development Co. Ltd., (Anglo American Corporation)	1962	19.6	1	27	22	31	[illegible]
CANADA Belledune New Brunswick	East Coast Smelting & Chemical Co. Ltd., (Noranda Group of Companies)	1966	17.2	1	26	19	22	19
EUROPE Avonmouth No. 1 England	Imperial Smelting Corporation (N.S.C.) Limited	1950–1959	5.1 → 9.3	2	-	–	–	–
No. 2		1962–1967	6.4 → 12.4	2		–	–	–
No. 4		1967	27.1	2	46	18	51	16
Swansea Wales		1960	17.2	2	44	17	50	20
Noyelles-Godault France	Société Minière et Métallurgique de Penarroya	1962	17.2 → 24.6	2	46	19	49	20
Duisburg Germany	'Berzelius' Metalhutten G.m.b.H., (Metallgesellschaft A.G.)	1965	17.2	1	44	21	68	33
Copsa Mica Rumania	Uzina Chimico Metalurgica	1966	17.2	2	40	17 Cu 2¼	36	17
Miasteczko Poland	Huta Cynku "Miasteczko Slaskie"	1963	17.2	1	42	19	4	2

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