Substitution of scarce metals with special reference of standardisation in India

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IN THE context of present economic conditions of the country, the substitution of scarce metals has assumed great importance. The foreign exchange position of the country has compelled the Government to think of various ways for the conservation of foreign exchange. It is, therefore, important that use of scarce metals should be minimised as far as possible.

Considerable amount of foreign exchange is drained out annually for the import of various scarce metals for the need of industries. Most of the non-ferrous metals are scarce in India. The position varies from quite abundance in case of aluminium to deficiency in the case of copper, lead and zinc and a total absence in the case of nickel and tin. Table I below will give an idea as to what a colossal amount of foreign exchange is involved in the import of some of the non-ferrous metals.

TABLE I Import of Non-ferrous metals

	Value in Rs. lakhs		
Commodity	1961–62	1962–63	1963–64
Copper	2345	2528	2666
Nickel	156	149	178
Lead	259	269	335
Zinc	735	902	986
Tin	578	511	640

It is, therefore, needless to emphasize the necessity of saving foreign exchange through proper conservation of scarce metals. The country is advancing fast through the age of industrial revolution and it is all the more necessary to think about proper conservation of scarce metals and alloys through substitution or through economical use so that there is no hindrance in the progress towards the goal. The only metal which is abundantly available in the country is aluminium. Though aluminium itself is in short production, compared to its present demand, there is enough scope for its increased production. Therefore the question of substitution should always be considered in terms of aluminium wherever possible. Aluminium holds a very prominent place as a substitute metal because of its important characteristics like lightness, resistance to corrosion, high electrical and thermal conductivities and high reflectivity, attainment of high strength in alloy form, etc. Therefore, there is enough of scope for its use as a substitute material wholly or partially in electrical conductors, chemicals and food processing equipments, canning and packing industries, domestic untensils and for structural applications in railway rolling stock, automobiles, aircrafts, etc. Aluminising of articles is a recent development and if adopted in place of galvanizing, it may alone lead to a saving of a considerable amount of foreign exchange which is otherwise spent annually for the import of zinc.

Besides the question of complete substitution, possibility of recovery of metals from various foundry waste, such as dross, ashes, slag, etc. and reclamation of scraps should be looked into with more priority basis. The use of virgin metals should be minimised as far as possible. Variety reduction is another important thing which needs due attention for the economical production and use of material.

The economic use of scarce metal and its substitutions can be best achieved through standardisation. It may be recalled that when similar economic condition hit the European countries, during the last World War, a number of emergency specifications were issued. The main features of these specifications were (a) rationalisation and reduction of varieties, (b) relaxation of the chemical requirements to allow the use of scrap, (c) lessening the use of virgin metals, and (d) substitution of more costly and scarce metals and alloys. These specifications were mandatory, by a law, for both the users and the producers to be implemented during the emergency period.

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The emergency specifications were also issued during the same period by the Indian Railways and the then Ministry of Defence. It is worthwhile to mention that the Indian Railway Standard for oil-lubricated locomotive bearing was revised allowing 20% tin in place of 60% resulting in saving a good proportion of the costly metal, tin. The Indian Standards Institution, since its inception after independence, is aware of the problem of scarcity of metals. Shortly after independence, the need for conservation of steel through efficient use of available resources assumed urgent importance for a speedy development of national economy. The Government of India entrusted Indian Standards Institution as early as 1950 with the responsibility of taking up a steel economy programme involving formulation and implementation of standards relating to steel production and use. Four years' intensive study at the ISI secretariat and by the expert committee resulted in the formulation of Indian standards, an improved and rationalised series of beams, channels, angles, the bars and bulb angles. While formulating these standards, note had been taken of many factors, such as production of standards current at that time in India, limitation and capabilities of existing mills and of the new mills being installed, the national standards and the competitive company standards introduced in other countries. It is worthwhile to mention that at a recent study made by the National Council of Applied Economic Research, it has been stated that an overall saving of about 23 per cent of steel can be achieved if all the standards and codes of practice published under 'Steel Economy Programme' are fully implemented.

Another important programme initiated by ISI related to standardisation and rationalisation of carbon, alloy and tool steels. The indigenous production of alloy and special steels has been insignificant compared to the demand, with the result that practically all alloys and special steels required by the country were being imported. The technical committee took note of this fact and felt that in order to encourage the establishment of alloys and special steels industry in the country on a sound footing, it was necessary, as a first step, to reduce the number of such steels used by the various industries to ensure their manufacture in economical quantities. Due regard had also been given for conservation of nickel and molybdenum, as India does not possess resources for these important alloying elements. After detailed study and investigations conducted as regards present and future requirements of the country, it has been possible to publish an Indian Standard (IS : 1570–1961 Schedules for wrought steels for general engineering purposes) which brought down the variety of steels from approximately 1 000 varieties to 140 only. In the context of present emergency existing in the country and to ensure production of alloy and special steels in more economical quantities for defence requirements, further reviewing of IS : 1570 has been undertaken. The special committee set up for this has already considered further rationalisation of alloy and special steels and it is expected that it will be possible to further reduce the variety of steels to about fifty only.

Since the starting of Chinese aggression in 1962, Indian Standards Institution has been authorised by the Government of India to publish emergency standards or emergency amendments to the existing standards. Since then the following emergency standards have been published by ISI :

(a) IS : 2298–1963 Stirrup pump, single barrel for fire fighting purposes

(b) IS : 2299–1963 Metal helmets for civil defence

(c) IS : 2300–1963 Non-metal helmets for civil defence.

All the technical committees of the ISI are at present reviewing standards relating to all non-ferrous metals to consider substitution of scarce metals and alloys wherever possible. Mention may be made of the recent decision of a technical committee to substitute bronze by cast iron for water meter bodies. A draft Indian standard of aluminised steel core wire for ACSR conductors has been prepared and is currently under wide circulation. If this standard is implemented by all industries and users concerned, a saving of a considerable amount of foreign exchange may be achieved which is otherwise spent annually for the import of zinc.

A special committee has been recently set up in the ISI to review the existing standards on wrought copper and copper alloys and the standards relating to zinc, antimony, tin and their alloys. The committee already made a preliminary study of these standards with a view to reducing varieties, minimising the use of virgin metals, enabling the use of more and more scrap and considering substitution wherever possible. The recommendations of the committee on some of the important standards on copper and copper alloys are shown in Table I. The draft emergency amendments based on these recommendations have already been prepared.

In conclusion it may be said that there is considerable scope for the conservation of scarce metals by judicious use and by substitution. Current levels of consumption of imported metals can be cut down by rationalising designs, variety reduction, wastage reduction and other productivity techniques. The substitution, wherever proposed, should be established by pilot plant efforts and proving trials. Above all, efforts to augment domestic production of the metals in short supply should be strengthened. Schemes for the reclamation of scraps and recovery of metals from foundry waste products should be strengthened and expedited. Prospecting of mineral sources in the country for the rare ores should be intensified.

References

1. Handbook of Statistics, published by Indian Engineering Association, July 1964.
2. The Eastern Metal Review, Mid Year Number, 15th August, 1965.
3. Proceedings of Symposium on Light Metal Industry in India, published by NML, Jamshedpur.
4. Krishnamachar, B. S. : Steel Standards and Standardisation on country-wide Basis—Presented at United Nations Inter-Regional Symposium.

TABLE I Recommendations of the technical committee on some of the standards on copper and copper alloys

Indian standard	Particulars of existing grade/grades	Recommendations of the special committee
IS : 28-1958 Phosphor bronze ingots and castings	% Sn — 10, Min P — 0·50 —0·70 Pb — 0·25 Max Zn — 0·05 —0·5 Other elements —0·25 Max	The Committee recommended an alternate grade with the following composition which will be applicable for bearings meant for slow speeds : % Sn — — 6–8 P — — 0·3–0·5 Fe — — 0·3 Max Sb — — 0·1 Max Total impurities — 0·70 Max
IS : 292-1961 Brass ingots and castings	Three grades of brass ingots with copper 71-78, 67–72 and 64–68 per cent respectively, and three grades of brass castings with copper 71–81, 67-74 and 64-71 respectively have been specified	The Committee recommended that the first two grades should be kept in abeyance during the period of emergency. Moreover, in the remaining third grade of brass ingots a maximum of 0·6 per cent Fe was permitted in place of 0·5 per cent.
IS : 304-1961 High tensile brass ingots and castings	Three grades were specified as Grade 1, Grade 2 and Grade 3	The Committee recommended to retain Grade 1 only
IS : 306-1960 Tin bronze ingots and castings	Two grades were specified as follows : Grades: Grade 1 % / Grade 2 % Sn — 9·5–10·5 / 7·5–8·5 Zn — 1·5– 2·5 / 3·5–4·5 Pb Max — 0·50 / 0·50 Total of all elements other than above 0·15 / 0·15	The Committee recommended grade G2 only Further Pb content was relaxed up to 1·5 per cent Max.
IS : 319-1962 Free cutting brass roads and sections	% Cu — 55–60 Pb — 2–3·5 Fe — 0·20 Max Impurities other than Fe 0·30 Max	The Committee recommended relaxation for impurities (including Fe) up to 0·75 Max to allow use of more scraps to minimise use of virgin metals
IS : 320-1962 High tensile brass rods and sections	Three grades as 'Alloy 2' 'Alloy 1' and 'Alloy 3' were specified	The Committee recommended to retain only the grade 'Alloy 3'.
IS : 410-1959 Rolled brass plate, sheet, strip and foil	Four grades were specified in the specification as BS 70, BS 65, BS 63 and BS 60	The Committee recommended deletion of Grade BS 65
IS : 531-1959 Leaded brass strip for use in the manufacture of parts for instruments	Three grades as 'Alloy BS 59 Pb 2'', 'Alloy BS 62 Pb 2'' and 'Alloy BS 64 Pb 1'' were specified	The Committee reommended deletion of 'Alloy' BS 64 Pb 1' grade
IS : 1385-1959 Phosphor-bronze rods and bars, sheet and strip and wire	There were three grades specified in the standard as PB 23, PB 26 and PB 23 Pb	The Committee recommended to retain two grades only and gra PB 26 was deleted
IS : 2283-1962 Nickel-silver sheet and strip for general purposes	—	In view of short supply of nickel, this standard was recommended to be kept in abeyance during the period of emergency.

Discussions

Dr **B. R. Nijhawan** (NML) : Should we draw the standards of the substituted end-products first and ask the laboratory to proceed accordingly or should we do the substitution first ?

Mr **Rao** : Drawing up the standards first may not be of much help. In my opinion, we should try out the various substitutes first, find out their suitability for particular purposes and then make out the standards.

Dr **B. R. Nijhawan** (NML) : I fully agree with you. I raised the point because for the last few years, the ISI has been pressing us to draw up the specifications for aluminised products in India when in fact there is no production as yet of such products. The consumers and suppliers do not actually know what they want in terms of properties, coating thickness and all the other characteristics which are introduced by the process of aluminising. Now that the process is relatively on a firmer stand, we have taken up the job of drawing requisite specifications for different end-products bearing in mind all the requirements of the industry. Substitution is quite a different aspect and the standards have to be aligned to the end-products which the industry would accept. There is no use preparing standards just for the sake of standardisation and releasing them for circulation if these do not suit the industry.

Dr **D. Kumar** (Hindustan Aluminium Corporation Ltd., Renukoot) : The role of standardisation in the context of substitution has been very well emphasised by the authors. I would suggest that effective and prompt steps should be taken by ISI to standardise the designations used in case of aluminium alloys. At present different alloy designations based on the British, Canadian, French, Italian systems, etc. are being followed in India leading to a good amount of confusion and the use of a seemingly large number of alloys.

This needs to be systematised and, at the present state of development of our aluminium industry, can be easily attempted. The four-digit system of aluminium alloy designation and heat treatment evolved by the Aluminium Association of America after careful considerations of the various factors is the most rational one and ISI should give serious consideration to its adoption in India.