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TRENDS IN THE IMPROVING ECONOMIC USE OF ALUMINIUM(*)

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The reasons leading to the initial usage of aluminium for any given application are usually either technical or strategic. Considerations of weight, durability, appearance or conductivity may lead to the adoption of aluminium in preference to other materials or, alternatively, shortages of domestic supplies of other materials and of foreign exchange, may dictate the employment of locally produced aluminium.

Nevertheless, once an application is established for technical reasons and is seen to be commercially rewarding it will inevitably attract competition from other materials. Uses for strategic reasons are also under pressure, this time from Government sources, to make the best use of indigenous resources. Some examples of aluminium uses which have attracted competition are listed in Table 1.

Table - 1 COMPETITORS OF ALUMINIUM

Use	Reason for use	Competition
Electric conductors	Good price/conductivity ratio	Sodium conductors
Windows and building components	Durability	Plastics and plastics coated steel
Aircraft	High strength/weight ratio	Special steels
Foil packaging	Impermeability	Treated paper

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This emphasises the need for efficient design to keep costs to a minimum, even when the application is based on sound technical reasons. The principal ways in which the costs of aluminium construction can be reduced are:

(1) Reduction in Dimensions and Weight

Every design includes a factor of safety to allow for uncertainties of behaviour. The more that is known about the performance of aluminium in service the easier it is to design efficiently without waste of metal. Thus, the accumulation of laboratory data on corrosion, creep, fatigue and other factors will assist designers to economise in the use of metal. Another way of decreasing metal weight is the development of stronger alloys with other properties equal to those of the alloys they replace, although the durability of alloys usually decreases as the strength increases.

(2) More Efficient Use of Metal

The safety factor used in designing aircraft structures is about 1.2, whereas in engineering structures it is usually 2 to 3. Yet aircraft are just as safe as highway bridges or dragline booms.

The difference lies in the greater testing and more accurate design methods adopted by the aircraft engineers. Similar techniques adopted by structural engineers would lead to more efficient structures and less wastage of metal.

(3) Improvements in Methods of Proection

Designers dealing with problems of deterioration in service can either allow sufficient metal to take care of the deterioration or they can provide some means of protection to prevent it. Aluminium, fortunately, is amenable to a number of protective treatments, such as anodising, lacquering, painting and chemical conversion coating that will preserve both an attractive surface appearance and the underlying metal against attack.

(4) New Concepts in Design

Engineers and designers faced with a new material often try to handle it by the same methods as those to which they are accustomed. Thus, early motor-cars strongly resembled horse-drawn carriages and the first

cast iron structures were designed with joints of the type used in wooden structures. Similarly, aluminium has often been treated in the same way as the metal it replaces. However, by recognising that it has many special properties such as high formability, and extrudability etc., skilled designers can produce more efficient and therefore more economic structures.

Some examples of how the principles outlined above have been applied in practice are:

1. The thickness of roofing sheet has decreased substantially over the years as a result of increased knowledge of the rate of corrosion and of the design of profiled sheet.

2. Canning applications provide a striking example of downward trends in dimensions. Twelve years ago beverage cans were being made with weights of 32 grm. Now, similar cans are available at half the weight.

3. Al-Mg-Si structural alloys have been standardised and codes of design practices established that enable more efficient and cheaper structures to be designed.

4. In electrical power cables aluminium is already an attractive alternative to copper. However, by departing from the designs established for copper and utilising the properties of aluminium, a cheaper and more efficient cable can be produced.

5. Development of welding techniques and weldable alloys has contributed to the more efficient design of road transport vehicles, ships' superstructures and heavy engineering plant.

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