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PROCUREMENT OF METALS NEEDED BY YUGOSLAV RAILROADS AND TELECOMMUNICATIONS SYSTEMS

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For construction of Yugoslav transportation facilities, installations, and structures, sufficient quantities of the following metals and alloys must be procured:

1. Iron and iron alloys, especially various types of structural, tool, and special steels, principally those alloyed with elements available in Yugoslavia, such as carbon, silicon, manganese, chromium, vanadium, molybdenum, aluminum, and copper.

2. Copper and copper alloys, especially various types of regular and special brass and tombac, red castings, tin and lead bronze, tt /Tuc-Tur?/ bronze, and German silver.

3. Zinc and zinc alloys, especially alloys that can substitute adequately for aluminum and brass.

4. Lead and low-melting-point alloys, such as various types of white metals with tin and lead as the base and various soft solders and alloys for use as metal plugs and low-melting-point fuzes.

5. Aluminum and magnesium alloys, especially those used in transportation and telecommunications (duralumin, silumin, alumian, and aldrey /aluminum sulfate/) because of their mechanical resistance, chemical stability, and electrical conductivity.

In addition to the above metals and alloys, certain quantities of the following are needed: wolfram (for use in light bulbs, high-speed steel, and other special steels); alumino-Thermit manganate (for production of special brass and bronze alloys, and for deoxidizing certain copper alloys); cobalt (for production of special tool steels, hard magnetic steel, various alloys with high electrical resistance, etc., nickel (for production of special structural and nonmagnetic steel, alloys for rheostats, for stoker copper, for refined white metals, German silver, etc., silver (for manufacture of special electric terminals and

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fuzes, production of silvered copper rods used for welding copper stoker parts, and manufacture of silver solder; antimony (for production of white metals, low-melting-point alloys, and plug alloys); arsenic (for stoker copper and refining white metals) cadmium (for refining white metals and production of tt bronze); phosphorus (for production of alloying compounds used for deoxidizing nonferrous metals and alloys, and injection of phosphorus into bronze); mercury for thermometers; selenium; platinum (for manufacture of special thermobatteries, electric-current terminals, and laboratory receptacles); and rhodium (for platinum-rhodium alloys and manufacture of thermobatteries).

The metals and alloys which would cover almost completely the needs of transportation and telecommunications are:

1. Basic metals and metalloids (used also in their pure form)

   a. Light metals: aluminum
   b. High-melting-point metals: iron and copper
   c. Low-melting-point metals: zinc, lead, tin
   d. Precious metals: silver and platinum
   e. Hard metals: wolfram
   f. Liquid metal: mercury
   g. Metalloids: selenium

2. Alloying metals and metalloids

   a. Light metals: magnesium
   b. High-melting-point metals: nickel and cobalt
   c. Low-melting-point metals: antimony and cadmium
   d. Hard metals: manganese, chromium, vanadium, and molybdenum
   e. Precious metals: rhodium
   f. Metalloids: carbon, silicon, phosphorus, and arsenic

Many of these metals and metalloids are produced in Yugoslavia from domestic minerals. Furthermore, conditions are favorable in Yugoslavia for producing other needed metals from domestic minerals; therefore, only a few metals would need to be imported.

The 12 metals and other elements needed in Yugoslavia in the largest quantities are iron, carbon, manganese, aluminum, copper, zinc, silicon, chromium, nickel, magnesium, lead, and tin. The need for wolfram, molybdenum, vanadium, cobalt, cadmium, arsenic, and phosphorus is much smaller, and the need for silver, mercury, and selenium, quite slight.

Of the 12 metals and metalloids needed in large quantities, nine are produced in sufficient quantities in Yugoslavia; the nine are iron, carbon, manganese, aluminum, copper, zinc, silicon, chromium, and lead). Yugoslavia does not yet produce magnesium, but can do so. Consequently, Yugoslavia lacks only two of the 12, nickel and tin.

Of the seven elements needed in smaller quantities, two, molybdenum and vanadium, are available in Yugoslavia in sufficient quantities. Yugoslavia produces cadmium also, but not in sufficient quantities. Yugoslavia should also produce arsenic and phosphorus. Practically, this means that only two of the seven, wolfram and cobalt, are lacking.

The requirements for platinum and rhodium for transportation and telecommunications are so small they need not be mentioned. The lack of nickel and tin, which are needed in large quantities, and wolfram and cobalt, needed in small quantities, make it necessary for the transportation and telecommunications network, and ferrous and nonferrous metallurgical industries, to find ways and means to reduce to a minimum the consumption of these metals.

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Yugoslavia's metal requirements can be achieved by the following methods: increasing and developing domestic metal production, decreasing metal consumption, efficiently organizing the salvaging of scrap metal, substituting domestic metals for scarce metals, improving the quality of, and standardizing, metal products and parts, and by importing only much needed metals.

Yugoslavia can increase and develop domestic metal production by opening new mines, raising the output of existing mines, and improving ore-processing methods. However, this work is the direct responsibility of the mining and metal industries.

The need is urgent for launching the domestic production of an extremely important alloying metal, magnesium, which is used in large quantities for producing various aluminum and magnesium alloys, and as an alloying element for tt bronze production. Otherwise, to fulfill its needs for this metal, Yugoslavia would have to depend solely on import.

No less important is the production of aluminum shot and Thermit. Aluminum shot is used in producing ferroalloys by the alumino-Thermit process. These alloys are highly important to the production of certain types of high-quality tool steels needed by workshops and metal industries, as well as for the manufacture, from domestic minerals like iron, aluminum, and chromium, of rheostats for electric furnaces. Aluminum shot is used also for producing pure manganese, which is used in turn in various copper and other alloys. In this way Yugoslavia will be able to reduce the consumption of wolfram, cobalt, and nickel. Production of domestic Thermit will make possible mass production of rail constructions, thereby reducing the need for small rail equipment, and diminishing wear on rolling stock.

To avoid further imports, Yugoslavia should begin producing arsenic, phosphorus, and sulfur, and increase the production of cadmium.

Reduced domestic consumption of metals can be realized mainly by reducing waste in the production and processing of metals, using metals sparingly in the preparation of designs and projects for various metal constructions and parts, and applying and strictly enforcing methods for preventing corrosion of metal parts. Corrosion alone destroys more metal constructions and parts in Yugoslavia than anything else, for it makes them unserviceable, so that they must be replaced.

To reduce metal consumption, Yugoslavia should explore all the possibilities of substituting nonmetals, especially synthetic materials. Yugoslav production of synthetics is in its initial stages at present; it should be developed and expanded as soon as possible, especially where metal substitutes are concerned. Polyvinyl compounds of Vinidur type are promising substitutes for stainless steel, pure lead, and tin. They may also be used for enamelware.

To reduce lead consumption, the possibility of substituting lead-tellurium alloy for pure lead should be explored. Tellurium, added to lead in proportion of some ten thousand parts to one of lead, makes an extremely hard and resistant alloy. In many cases, the use of this alloy as a substitute for lead would reduce the consumption of lead one third to one fifth.

Another way to reduce metal consumption, especially by railroads, is to substitute steel of low silicon content for carbon steel with a hardness of 37 kilograms per millimeter, for bridges and other steel constructions. Steel of low silicon content has 25 percent higher tensile strength than ordinary steel, and its use would reduce iron [steel?] consumption considerably. Production of this steel would not be difficult. At the same time, the problem of manufacturing electrodes suitable for welding this steel should be solved.

Another problem is the production of railroad rails, cast railroad switches, and intersection rails from austenite-manganese-steel. By using these rails instead of the ordinary carbon-steel type in places where the traffic is heavy, Yugoslavia should be able to reduce iron consumption considerably.

Simultaneously Yugoslavia must solve the problem of producing Grover [piston] rings domestically from low-alloy manganese-silicon spring steel. This problem could be solved rather easily, as it is pure waste to have to import this steel in large quantities.

A generally satisfactory solution of these and similar problems cannot be found if laboratories, experimental stations, and telecommunications establishments are left to do the job unaided. Consequently, the closest collaboration between rail and telecommunications establishments and the metal and chemical industries is necessary.

Efficient scrap-metal salvage must be systematically organized and enforced strictly in all industrial enterprises and workshops, at building sites, and everywhere it is necessary. In organizing scrap collection, the technical and monetary value of scrap metal depends mainly on the nature and contents of the scrap and the possiblity of nonmetal and other impure elements being present, the form and shape of the scrap, and the degree of its uniformity. Collection priority should be given to tin, nickel, aluminum, copper, zinc, and iron, in that order.

The value of scrap metal scales downward as follows: piece metal, turnings, clinkers, and ashes. Uniform scrap of the same metal has a higher value than nonuniform (a mixture of large and small pieces, a mixture of various types of turnings, etc.). Scrap obtained from processing new metals is usually relatively pure. The same is also true for scrap obtained from processing used metals from various metal constructions and old machinery. In practice, however, scrap metal is regularly obtained which contains additional metals or elements that not only lower its value, but also make its reprocessing difficult, and increase its refining cost considerably. It is important therefore that the above be kept in mind when organizing the collection and grading of metal scrap and waste.

Scrap should be retained no longer then necessary at collection depots and warehouses, and shipped immediately for furtherutilization in its present form, or for reprocessing, melting, etc.

The difficulty of substituting domestic and more plentiful metals for scarce metals is due to the fact that no substitute is completely equivalent to the metal substituted. For instance, the problem of substituting for tin in making tin foil is quite different from substituting for tin in the production of white metals, or as a component part of low-melting-point soldering alloys, or in the manufacture of printing type, etc. On the other hand, none of the methods successful in the above cases may be applied in substituting for tin in bronze manufacture or the like. Consequently, each instance where one metal is substituted for another must be considered individually and treated accordingly. These problems are further complicated by the fact that sometimes no general method may be found for using a particular substitute. For instance, lead foil may be substituted for tin foil for some purposes; yet it cannot be substituted by the food-packing industries, where aluminum instead of lead foil must be used. Likewise, in a great many cases lead may be used instead of tin for the production of white metals; in other cases (the manufacture of housings for high-rotation bearings exposed to high pressure), lead cannot be used. Sometimes tin can be entirely eliminated by using white metals made from a lead base with the addition of small quantities of calcium, sodium, and lithium, or even by using lead bronze. Tin used in bronze and red castings production may be partly or even completely substituted by using extracted red castings for pure tin-bronze; silicon-tombac or aluminum-bronze for red castings, etc.

Another difficulty in scarce-metal substitution is that it increases the number of scrap-metal types to be salvaged and reprocessed.

Therefore, the problem of using substitutes for scarce metals should not be left to individual production branches and enterprises for individual solution in each case, but should be treated as a whole and according to plan, with the closest collaboration of all production branches concerned.

It must be emphasized that, in transportation and telecommunications, Yugoslavia is primarily interested in finding substitutes for wolfram, cobalt, and nickel, which are used in producing high-speed cutting steels and other medium and high-alloy tool steels. A substitute is needed for nickel used in alloys for electric resistors and steels for cementing. A substitute is also needed for tin in producing white metals, soft solder, and low-melting-point alloys and bronzes.

Improving and standardizing the quality of metal constructions and parts can contribute considerably to assuring a supply of necessary metals. Pointing to this is the excessively large percentage of rejects in Yugoslav foundries; the production defects that necessitate early replacement of various parts in metal constructions, machinery, and rails; and the high replacement rate of parts whose service is shortened unduly because of poor wear resistance, etc. These deficiencies are common to all branches of the metal industry and wherever metal is utilized.

For railroads, first priority should be given to improving the quality of cast parts made from gray, red, bronze, or brass casts and parts manufactured from light alloys. Simultaneously, the quality of production of tool factories should be improved.

The following should be standardized: the quality and number of types of various metal constructions and their shapes and measurements; machine and electric equipment; various elements of metal constructions; signal, telegraph, telephone, and radio parts and installations; railroad equipment, tracks, and switches; and all other constructions, installations, equipment, and structures where metal parts are used.

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