D00203

United Nations Industrial Development Organization

Distr.
LIMITED

ID/WG.46/7
22 September 1969

ORIGINAL: ENGLISH

Expert Group Meeting on the Utilization of
Non-ferrous Scrap Metal in Developing Countries

Vienna, Austria, 25 - 29 November 1969

SOURCES OF NON-FERROUS SCRAP METAL AND ALLOYS AND THEIR PREPARATION FOR MELTING AND RECLAMATION 1/

by

Frumosu Ladislau

Chemical-Metallurgical Plant "NEFERAL",
Bucharest, Romania

1/ The views and opinions expressed in this paper are those of the author and do not necessarily reflect the views of the secretariat of UNIDO. This document has been reproduced without formal editing.

id. 69-4774

CONTENTS

INTRODUCTION

The importance of **secondary** non - ferrous metallurgy is increasing. This is explained by the continuous growth in importance of non - ferrous metals and alloys obtained from old metals and scrap. If we consider also the fact that non - ferrous metals are in short supply, then, the rational use of non - ferrous old metals and scrap metals, becomes a problem of general interest.

Some of the research works carried out have demonstrated that the losses of non - ferrous metals, from the moment they are extracted, to the amortization of the part (due to corrosion and wear) reach some 25%.

An important contribution to the reduction of this high percentage of loss can be made by the **rational** use and processing of nom - ferrous old metals and scrap metal.

a country with a planned economy there are all the conditions required for the study of the sources of non - ferrous metals, including therefore scrap and old metals.

It is particularly important to know the sources of old metals and scrap, their origin and their clasification, in order to ensure their rational use.

It is necessary to provide for the adequate storage and transport of these metals, from their formation source, to facilitate their rational use.

These requirements can be met by introducing compulsory national quality standards for the clasification of old metals and scrap.

Speaking about the sources of these non - ferrous old metals and scrap metal, and about their preparation for melting and reclamation, the ultimate use must be considered when classifying, that is the rational reclamation of useful metals when using present tehniques. Thus, when a standard for non - ferrous old metals and scrap metal is worked out, one must take into account the grouping and the quality requirements claimed by the processing plant.

If the sources of non - ferrous metals and of scrap metal are known, one can provide a raw material that can be utilised rationally minimising the risk of mixing with undesired metals (ex. Al. in bronzes with tin or brasses).

If clean scrap without mechanical impurties is available, one can, by simply melting obtain , an alloy that has a similar or close composition to that of the used raw material. Thus, one can obtain directly from scrap the final product with minimum losses (only melting losses). Any other suplementary stages of metallurgical processing such as refining, wich lead to further losses of useful metals, are avoided.

If the sources of old metals and scrap metal are known, the planners can work out a balance of secondary non - ferrous metals. On the basis of this information, the plan for collecting is worked out.

At the present time scrap and old metals for which collecting and processing are organized, vary from one country to another, take account of degree of industrialization of each country. Thus, in Roumania the following scrap metal and their respective alloys are collected and processed : copper, alluminium, lead, nickel, zinc, tin and tungsten.

In more advanced countries, the range is more extensive. Thus, metals containing magnesium, cobalt, molibden, mercury, titanium and cadmium are collected.

The range of processed scrap metal becomes larger with the increase of technical progress and of industrialization.

Non - ferrous scrap metal is a residue from all the stages of metallurgical processing, either as process scrap or as rejected parts, and are as follows :

1.- Scrap from the rolling and forging process (ends, cutting, burrs, scraps, crop-ends from ingot cutting, or surface cleaning, cinder, etc);

2.- Scrap resulting from metallurgical processes (slag, leakage, build up, etc.) ;

3.- Foundry scrap (teeming, head metal, leakage, slag and others) ;

4.- Scrap from cable manufacturing processes (cable ends, wires, etc.) ;

5.- Scrap from mechanical processing (punching, cutting, etc.) ;

6.- Scrap resulted from zincing and tinning processes (sludge cinders, etc.) ;

7.- Scrap from chemical processes ;

8.- Rejected parts from technological processing.

Old metals representing worn out parts and assemblies, which can be grouped as follows :

a)- old metals from industry, from transport, from agricultural equipments and from discontinued installations);

b)- old metals from military sources (planes, weapons, unprimed ammunition, etc.) ;

c)- domestic articles collected from houses and from domestic waste dumps.

In socialist countries there are specialized enterprises which collect non - ferrous old metals and scrap metal and others, which process in a centralized way, various types of non-ferrous old metals and scrap metal.

The enterprise for metal collecting registers all the sources of old metals and scrap, providing for their collection and transport to processing plants.

This enterprise also carries out some of the operations for separating non - ferrous metals from ferrous ones and for separating non - ferrous metals from each other and from organic substances, being well-equipped for this purpose.

In the Socialist Republic of Roumania, the following preparation operations are carried out by the enterprise which collects the scrap:

1.- Heat processing of covered non - ferrous metals ;

2.- Removal of sheaths from cable cores ;

3.- Processing of aluminum cables with steel core ;

4.- Reclamation of scrap metal from electric light bulb base ;

5.- Dismantling of electric motors and the removal of field armature;

6.- Removal of lead-layers from scrap steel,and from lead-coated old steel;

This operation is carried out by the electrolytic method in an alkaline solution.

7.- Reclamation of lead plates and lead sludge from worn out accumulators ;

8.- Separation of metal parts from iron-nickel accumulators ;

9.- Reclamation of soldering alloy (Pb - Sn) from radiators by heat treatment ;

10.- Electrolytic reclamations of tin from scrap tinned sheet using the principle of tin removal in alkaline solution.

Several classic operations of sorting are carried out by the enterprise which collects the metals and these are: dismantling, gear cutting, guillotine cutting, dismantling by locksmith's method, electric or autogenous cutting, pressbaling etc.

Specialized works usually carry out the more advanced preparation or that preparation requiring more complex plant.

To ensure rational processing it is esential to ensure adequate clean storage at the source, to prevent ensuring contamination.

Transport in containers, according to categories,groups, assortments ,etc.,eliminates the possibility of contamination,is included in the requirements for rational reclamation.

All these are precursory aids, but necessary in order to precondition old metals and scrap to ensure rational melting and reclamation.

I. THE CHARACTERISTICS OF SOME CATEGORIES OF OLD METALS AND SCRAP

Non - ferrous scrap and old metals are classified into categories, groups and assortments.

This classification is a function of the characteristics of old metals and non - ferrous scrap, of the degree of impurity, and the possibility of utilisation under the most rational conditions.

Old metals and "good quality" scrap (the so called clean ones) are used for forming batches for the direct preparation of secondary alloys, without the necessity for other stages of metallurgical processing.

Non - ferrous old metals and scrap (non-purified) must pass through various stages of metallurgical processing (such as : slag, cinders, nonpurified old metals, etc.).

Grouping into precise categories of each scrap metal or old metal, from the very moment of its formation, adequate storing and transport avoiding contamination, are basic conditions for the rational use of secondary non-ferrous metals.

Taking into acount the technical level of the scrap processing works for the optimum utilisation of the raw material available within the plants of non - ferrous metallurgy, the sections for processing old metals and scrap are usually provided with three distinct process lines, namely :

a)- processing of scrap and old metals in pieces ;

b)- processing of cuttings ;

c)- processing of oxidic scrap (oxides, cinders, slag, etc)

This way of organizing the lines for primary - processing old metals and scrap provides some semifinished products which converge at batching provide secondary non - ferrous alloys. This happens with old metals and scrap in sorted pieces, processed cuttings, bronze or copper for the converter, obtained from oxide scrap and old metals in pieces and impurified cuttings that cannot be separated by preparation. They enter in various proportions in the composition of batches prepared for preparing alloys.

The above mentioned will be demonstrated when speaking about technological processes.

Within primary processing there result also secondary products which are usually eliminated from a process line and passed into another. This happens, for instance, with rejected pieces from the magnetic removal of iron from cuttings. These are sent for melting into the shaft furnace together with the oxidic scrap or old brass in nonpurified pieces (which cannot be disassembled), and which are processed with the batch of raw bronze in the converter.

Secondary non - ferrous metals, the old metals and scrap, are directly charged into some stages of the technological process of melting or refining. In this way they are not passed through the primary processing stages.

For example it is rational that bimetals Fe.-Cu., Fe.- brass, Fe - tombac should be directly charged into the shaft furnace , where they act as a flux element, and the nonpurified brass scrap due to the zinc content as a heat agent.

This way of working is applied only as a consequence of knowing the chemical composition of the scrap, or of the old metal.

In conclusion, the knowledge of the raw material characteristics enables the use of the most rational method of processing.

A. The Characteristics of Old Metals and Scrap with Copper content

1.- Pieces of old metal and scrap metal of bronz, brass, copper, and other alloys containing copper.

This category includes large sized scrap such as "build up" or big leakages of metals which usually result from metallurgical processes. They can reach tens of tons and they have not a homogeneous composition. They often contain foreign bodies as well.

-Over sized parts from equipments that can no longer be used, or rejected parts (for instance in propellers, copper boilers, copper injectors etc.). They are small clean or they can be separated from harmful metals by the known methods.

- Scrap from industrial manufacturing processes (frequently contaminated) must undergo the sorting process.

- Artillery cartridge tubes or largebore cartridge tubes can have very different compositions.

Artillery tubes are made of pure brass and only require to pass an unpriming process after which they are subjected to the pyrotechnical control process.

Some cartridge tubes are made of bi - metal an therefore have high iron percentages, some of them even in heavy paper cases (those for hunting rifles). Impurity can oscillate between 2-90%.

Due to the danger resulting from the presence of water or mud in these tubes which have been recovered from the field, all must undergo the pyrotechnical control, and require an adequate quality certificate.

- Scrap of brass and copper radiators represent a very significant quantity, so they are treated separately.

- Old metals and domestic articles are usually mixed and very impure.

- Wire and cable scrap can vary very greatly in appearence and composition. Some are insulated with rubber, some with plastic, paper, silk or cotton yarn, sometimes they are enamelled or provided with lead and with iron armour.

Armoured cables usually contain from 3o to 6o% copper. They are broken down and most of the wires are used directly for batching as they are clean.

Small metal scrap from electrotechnical plants,etc., such as punchings, ends are usually very impure, they are subjected to copper sorting processes and only if this is not possible, are they sent to melting and heat refining.

- Bimetal scrap (Fe-Cu, Fe- brass, Fe-tombac) is recovered as sheet, tubes, punchings,etc.

The non - ferrous metal layer is usually thin, representing 6-8% and in the case of galvanic coatings 2-6%. The amount of non - ferrous metal decreases even more if kept in the open air. Only in very rare cases does the non - ferrous metal content reach 3o-5o%.

2.- Cuttings can be clean or impure

Their impurity can oscillate between 1-4o%. They usually contain moisture, oils, emulsions, mechanical iron and earthen impurities and sometimes other non - ferrous metals.

Clean cuttings are used directly in the production of alloys. Only the impure ones are melted and heat-refined.

Their contamination with non - ferrous metals can be very serious, as for instance in tin bronzes or brasess.

3.- Copper oxidic scrap represented by slag, leakages, cinders, sweepings, etc., represents a very important quantity of raw material out of which copper is extracted.

Cinders and slag collected from various foundries in the country are heterogeneous in origin, containing floot sweepings, foundry earth and pieces of refractory materials or bottoms of graphite crucibles. They come from melting and casting of copper, bronzes and brasses.

Their chemical composition can be characterized as follows :

12-45% Cu; lo-3o% Zn ; o-2% Sn; o,5-2,5% Pb; o-2% Fe ; Fe. oxides 6-16%; 8-2o% Si.O_2; 4-14% Al_2O_3; 1-8% Ca.O; o-2% organic compoundes; 3-15% moisture content.

Grading composition varies from ± lo mm and larger up to o,2 mm.

- Slag from the converters and from the rotary furnace or hearth furnace can result either from the respective plant or from other plants. The chemical composition can be very complex and can be independent of the origin of the melted and refined raw material and of the type of furnace and techological process from which the slag was obtained.

Usually they contain an important amount of flux.

B. <u>Old Metal and Scrap with Zinc content</u>

Specific to this metal is the fact that only 1/4 of the resources represents old metal, or the metal resulting from depreciation. They are mostly printing plates, worn out carburators, various parts of obsolete equipment.

Scrap resulting from the fabrication process consists of cinders and sludges from iron zinc plating.

Some of the scrap results from mechanical processing (about 15%) as plates, bars, etc.

C. Old Metals and scrap containing tin are mostly obtained from antifriction alloys, and namely from the fabrication of bushings and bearings. They originate either from obsolete equipment or from current fabrication in th form of cinders and cuttings.

Some of the tin scrap results from the hot tinning of steel sheets, they can be delivered as ash with minimum 65% Sn and cinders with pickling agents.

D. The Characteristics of Old Metals and Scrap containing lead

Lead scrap has two basic forms :

1.- Lead metal scrap from dismantled equipments including rolled products, scrap from antifriction alloys, lead scrap from bullets, and from cables, etc.

Scrap rolled-products usually from chemical plants and especially from sulphuric acid chambers, antiacid bath linings, tubes, antiacid valves, spirals, etc.

Contamination of lead sheet is between 1-3% and of lead tubes between 3-5%.

- Scrap and old metals from cables. Numerous types of cables are manufactured. Several types have an external lead sheath, and inside they have copper or aluminium wires often with iron re-inforcing and wires with the insulation material.

These lead sheats are made from electrolytic lead. Acumulator lead of AC_2, AC_3 type contains sometimes antimonium from o,4-o,8%, or o,o5 - o,o8% copper. In several countries, Sn up to 2% is also included in the composition of lead sheats for cables.

The average lead content in the cables raw scrap is 3o-35% for armoured power cables, about 45% for non-armoured power cables and 5o-55% for low current cables such as telephone cables.

After breaking down the lead sheath is retained with an average content of impurities of 2-6% due to contamination with oxides, oils, and dust.

Lead Scrap from bullets, from shells is processed separately.

Bullets have a lead content of about 6o-65% of the bullet's total weight, due to the fact that in the metal (bi-metal) jacket, antimonious lead with 1,5-3% Sb content is cast.

Shell lead is also an antimonious lead with lo-18% Sb content.

Their impurity content is about 1%.

- Hard lead scrap as cast parts comes from chemical plants. These are pump, casings, valves, tapes, lugs, etc.

Their impurity content is 1-2%

This typ of scrap is used for producing Pb-Sb alloys and for producing antifriction alloys.

Scrap from antifriction alloys (of the type Pb,Ca Na; Pb - Sb - Sn - Cu, etc) of the babbit type is partially processed by recycle in the railway units and workshops where bushings are cast, and most of them in the metallurgical works for secondary non - ferrous metal.

Impure scrap or scrap with a declared content (especially for the alloy Pb - Na - Ca in which the Na - Ca content does not reach 1%, due to burnings) is sent to the works of non - ferrous metallurgy.

Antifriction alloys scrap comes as bushings, cast ingots and cuttings.

The impurity level is different for each of them. Thus, for bushings it is 5-10% and for cuttings 5-6%.

Often this scrap comes mixed with tin or bronze scrap, therefore it has to be carefully treated.

2.- The following belong to the group of lead oxide scrap :

- accumulators scrap ;
- cinders, slag, accumulator sludges, etc of which the accumulator scrap has the greatest weight.

In the present day many types of accumulators are manufactured for : cars, naval constructions, electric engines, stationary batteries, etc.

The accumulators consist of the plastic box, the lead plates providing positive or negative electrodes and the plastic perforated separators.

The electrodes are connected by bridges. When processing plates, bridges, contacts and sludges are treated separately due to their different compositions.

The accumulator plates have the following chemical composition:

- Pb - Sb alloy networks with 2-10% Sb ;
- The active mass consisting of high oxides and lead sulfates contains 73-81% Pb, 0,3-0,5% Sb, 5-7,5% S.

The composition of the plates, which are carefully sorted, is the composition of an accumulator lead alloy with a very reduced impurity content, as they are made from high purity lead (AC_2 or AC_3 electrolytic). In some countries only the bridges are cast from technical lead, and this is why it is recommended to have them separated for sorting.

The accumulators used in naval constructions have bridges with a brass muffle, which represents about o,7% lead weight in the battery.

The accumulator scrap contains large amounts of oxygen and sulphur. Moisture content varies according to season and storing conditions. Lead paste moisture content is 4-10%.

The scrap of sorted accumulator plates contains more than 80% Pb and 2-3% Sb, the rest being oxygen, sulphur and moisture.

The plants usually receive the accumulator scrap with 70-80% (Pb + Sb) due to the presence of separators, parts of boxes and other impurities. Data on this varies from one enterprise to another.

The small parts from breaking-down contain about 60-70% (Pb + Sn).

Lead cinders and slag have a very varied composition. The moisture content of cinders differs with the season and means of transport and conditions of storing.

Up to 5% moisture content is considered as average. Besides lead cinder at secondary non - ferrous-metallurgical plants, cinders, from the melting of antifriction alloys based on lead or tin are also brought for processing.

Tin cinder contains 15-45% Sn up to 25% Pb and other non - ferrous metals. Cinder from antifriction alloys based on lead, contains up to 5% Sn up to 50% Pb and other metals.

In this group of scrap is included the earth from shooting grounds but it is poor, and therefore before being sent to lead plants it has to be previously screened to become rich.

E. The Characteristics of Old Metals and Scrap containing Aluminium

Taking into account the technological processing operations, aluminium old metals and scrap fall into 4 groups:

1.- Old metals and scrap in pieces ;

2.- Cuttings ;

3.- Cinders ;

4.- Other old metals and scrap.

1.- Old Metals and Scrap in Pieces

The following are included in this category :

a)- Old metals from sheet, and laminated products and scrap obtained from their processing ;

b)- Old metals from wire, and scrap obtained from wire fabrication ;

c)- Old metals from cast and forged products.

a)- To the first group belongs old metal from aviation namely: fuselage, cabin wings, etc.

They are made of duralumin metal or of steel plates covered with duralumin metal plates. They contain several ferrous parts or parts made from copper wire (from the internal installation) as well as other parts made from other metals or alloys, and are thus considered as the most complicated of old metals. They contain such metals as : lead, copper, magnesium alloys, copper alloys such as bronze and brasses and other types of aluminium alloys, with composition different from that of duraluminium metal.

The old metals of naval origin are obtained from breaking down motor boats, pontoon bridges, boats and others.

The old metals from naval constructions are based on anticorrosive aluminium-magnesium alloys.

- Sheet waste such as strips, ends, punchings, etc, form a big amount of scrap.

This represents one of the most valuable category of Al.scrap, as it is very clean.

Sometimes one can find mixed with them scrap of textolite, plastic, pickled sheet zinc covered sheet, copper sheet,etc.

Sheet waste can be pure aluminium or aluminium alloy. Several times these sheets are painted with protecting varnishes.

The impurity level of this type of scrap is 3-4%,but it can also reach 20%.

Scrap from pressed, semifinished and rolled products consists of: sheet wastes, profiles, forging wastes etc.

They are usually very long and have no impurities (except Al_2O_3). Their composition is either that of duralumin metal or they consist of pure aluminium.

Pressing scrap can contain 2-3% of oil, and even more if it has been left in the dust.

Old metal in domestic articles comes from furniture, pots, sledges, etc.

b)- Old metal from wire products and the scrap from their manufacture consists either of pure aluminium, or aluminium alloys (usually duralumin metal).

Aluminium conductors may have a single wire, or several, or they can result from breaking down cables. Many may be insulated with cotton, rubber, polyvinyl chloride.

They are often covered with insulating varnish or mixed with zinc plated iron wire, and that is why attention must be paid to sorting operations.

c)- Old metals of cast and forged products are based on very different chemical compositions and in most cases they are contaminated with other metals (bronze, brass antifriction alloys bushings , based either on lead or tin, steel screws and bolts, etc.).

The degree of impurity in these old metals varies between 3 and 50%.

From dismantled air-planes, cars, tractors, tanks and other motors comes a great amount of motor blocks, pistons,cylinders, carters, cases, boxes,etc.

This type of material is very valuable as it is pure and cast from high grade alloys.

2.- Aluminium Cuttings and Aluminium Alloys

Cuttings can be tiny or spongeous, clean or mixed. Cuttings represent the most important weight in the group of old metals and aluminium scrap.

They are usually contaminated with iron, either as cuttings or parts from processing, or as dust resulting from the wear of processing cutters. Because of this, iron impurity may reach 50%.

Cuttings are contaminated with oils and emulsions. The moisture content can become greater due to storing in the open air, when oil and water content may even reach 20-30%.

3.- Aluminium Cinders

Cinders or slag are formed in various foundries which melt aluminium or its alloys without flux. The oxides formed on the surface of the bath include other impurities from the batch and melted metal recovered when cleaning the bath surface.

Aluminium cinders or slag are either in the form of powder, or in pieces.

Pieces usually contain 45 - 80% metal aluminium. The small pieces are less rich in aluminium and contain about 10-20% metal aluminium.

Long storage in the open air can reduce to zero the content of aluminium metal.

4.- Other Old Metals and Scrap Metal containing aluminium

Old metals of military origin are usually mixed, and that is why they cannot be used until they have been melted and anal sed.

This group includes also old metals from which there is the danger of an explosion on melting, and they must be pirotechnically controlled . Ballons, containers, pumps, carburators, etc, are included in this group.

Aluminium foil which is used for packing foodstuffs, for the manufacture of electrical condersers, for electrical screenings, for electronic equipment and radio sets, for heat insuelition, for water insulations,etc.

As it is 0,003-0,2 mm thick, in order to give a higher mechanical strength it is stuck to paper, cellophane, cardboard, etc.

Aluminium foil is to be found in the works as scrap from its manufacture, as aste from manufacture of condensers, unserviceable condensers, used packing paper, etc.

Aluminium foil is pure aluminium , but because it is mixed with paper, cardboard, etc., it is very difficult to process, thus it does not represent a valuable raw material for secondary non - ferrous metallurgy.

The waste from radio sets and electrotechnical indus-

United Nations Industrial Development Organization

Distr.
LIMITED

ID/WC.46/7/Add.1
21 October 1969

ORIGINAL: ENGLISH

Expert Group Meeting on the Utilization of Non-Ferrous Scrap Metal in Developing Countries

Vienna, Austria, 25 - 29 November 1969

SOURCES OF NON-FERROUS SCRAP METAL AND ALLOYS AND THEIR PREPARATION FOR MELTING AND RECLAMATION

Addendum 1:

Recommendations and Proposals 1/

by

Frumosu Ladislau
Chemical-Metallurgical Plant "NEFERAL",
Bucharest, Romania

1/ The views and opinions expressed in this paper are those of the author and do not necessarily reflect the views of the secretariat of UNIDO. This document has been reproduced without formal editing.

id.69-5446

1.- By knowing the sources of non-ferrous old metal and scrap, and by applying modern methods of preparation, both developing tendencies in this field, emergent countries are able to include in their development programmes, measures for the total utilisation of non - ferrous old metal and scrap.

2.- The conclusion of initiatives in this field undertaken by UNIDO for developing countries, and recommendations for technical assistance activities can contribute greatly to the industrial development of these countries.

3.- The reclamation of non - ferrous metal from scrap is a very important economical problem, both in theory and practice. Essential studies must be made in each country to determine the following:

- The sources of non - ferrous old metal and scrap,
- The quantities of non - ferrous scrap resulting from industrial production and the collection of old metal,
- The composition by grades and quality,

In consequence of these, the following are essential ;

- A good organisation for collecting old metal and scrap;
- Proper preparation for transport and storage ;
- Good methods preparation for melting and reclamation;

4.- The necessity to conserve non - ferrous metals as materials "in limited supply" and the growing importance of old metal and scrap in the metal balance of a nation, entail the setting up in all countries of special organizations for the collection of old metal and scrap.

Such enterprises should be responsible for :

- The storage of all grades of old metal and scrap;
- Collection;
- Their preparation for economical and safe transport
- All these features require the setting up of well equipped centres.

5.- To ensure maximum efficiency, the preparation of old-metal and scrap must be made in specialised sections only, using proper methods or equipment. The recovery of old metal and scrap provides an important supply of non - ferrous metals, leading,to improved levels of production and a consequent increase in the standards of workers.

6.- As part of an efficient policy of conserving non - ferrous metals, countries must introduce "National Standards" of old metal and scrap for the classification, especially for end products.

By this means contamination can be avoided and a uniform grading can be achieved.

The improvement in commercial relations demands "Unified Standards" and we propose to UNIDO that it should consider the introduction of these standards.

This would permit introduction in the future of unified classification marks for non - ferrous alloys, which would avoid expensive analysis of the scrap received for processing.

7.- The methods discussed are for the total recovery of useful metal and for this reason developing nations should organise these activities as part of their programmes for industrialisation.

As new types of scrap appear, their recovery must be arranged using the most suitable methods.

It is recommended that when new technical processes produce scrap,correct proposals for the reclamations of these metals should be made.

Because some categories of scrap are not efficiently prepared and the technologies are not stabilised in terms of the best recovery of useful metal, we propose to UNIDO that it should offer technical assistance to developing countries for necessary research work for determining processing techniques.

We propose research into the methods of preparing the following kinds of scrap.

- Aluminium foils and ashes
- Radios and electrotechnical scrap
- Electrotechnical scrap with precious metals
- Some types of bi-metal scrap
- Power cables having plastic sheaths
- Briquetted turnings

We propose to UNIDO that it should offer primarily technical assistance for determining the sources of non-ferrous old metal and scrap, to include in their development programmes measures for the organization of useful metal recovery.

8.- Because there is not adequate data on processing techniques used in the more developed countries, our meeting must determine the technologies so that UNIDO can offer technical assistance, for example, the preparation and sorting of aluminium turnings in heavy mediums.

9.- Because of a lack of technical information in this field, we consider useful the organising at UNIDO level of information on achievements, and to circulate this by means of periodical papers.

10.- We also consider useful the organisation by UNIDO of specialised courses for the "Rational Reclamation of Non-ferrous Metals".

11.- It is a proper measure for developing countries to introduce into [illegible] for reclamation of useful non-ferrous metals from old metal and scrap.

With regard to possible technical assistance activities, that would be undertaken by developing countries, we consider :

- Studies of old metal and scrap sources;

- The organisation of enterprises for collecting and preparing;

- Designing of units for preparing the scrap;

- Designing of melting and refining floors;

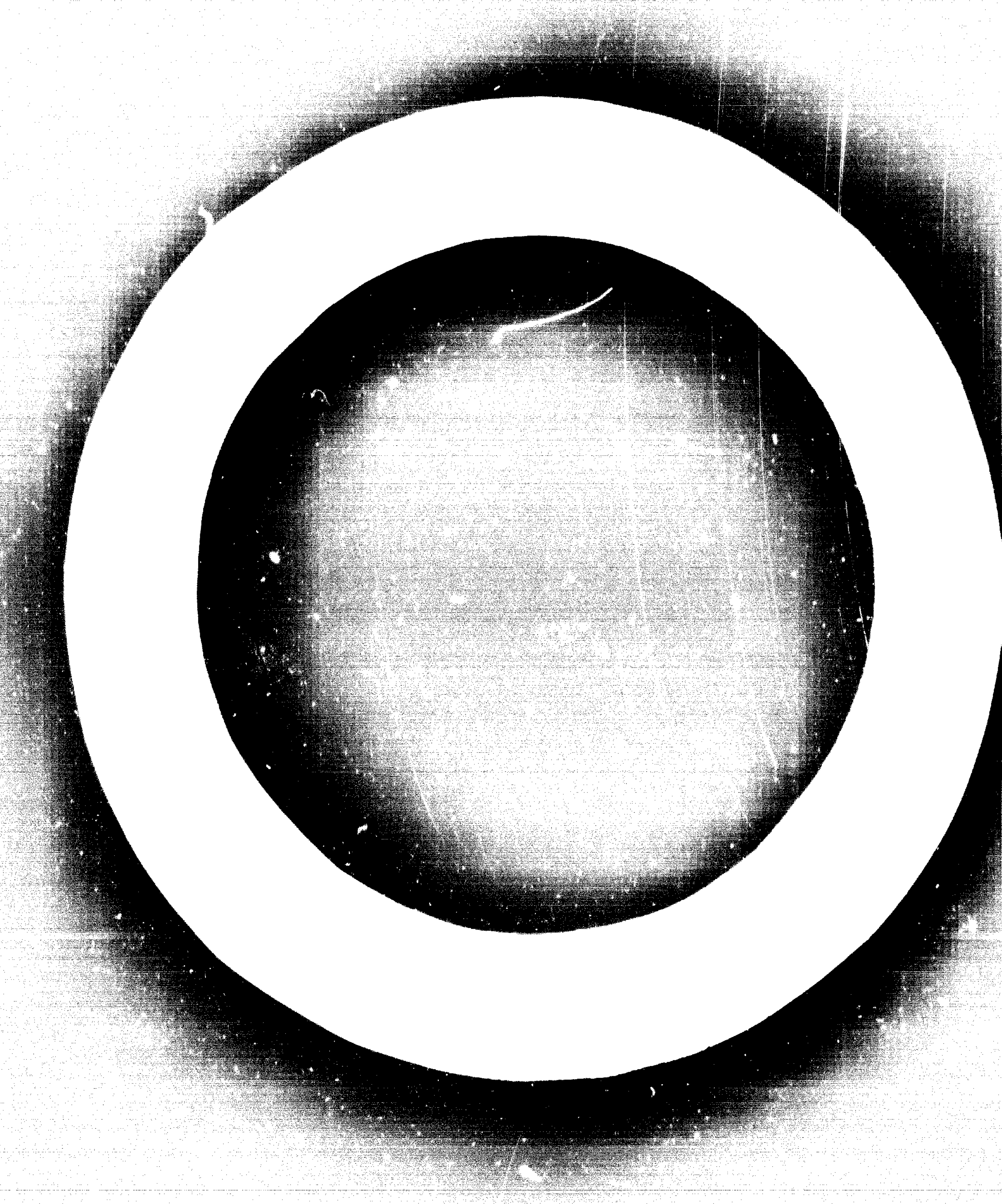
- Designing of units and of complete plants for scrap processing;

- Supplying of necessary equipment;

- Efficient training of staff.

Regarding all these activities, we emphasise, that Romania has some conditions, and can and does offer to developing countries technical advice for the reclamation of copper, lead, tin, zinc and their alloys, from old metal and scrap.

. . . .



tries contains a considerable amount of aluminium or aluminium alloys. It is a characteristic that they are mixed with copper wire, ceramic parts and other metals and materials.

II. PROVISIONS CONNECTED WITH A RATIONAL PRIMARY PREPARATION OF NON - FERROUS OLD METALS AND SCRAP METAL

- Acceptance, Discharge, Transport, Storage

As previously mentioned, the rational use of non - ferrous scrap metal and old metals depends upon their quality, for which reason high grade clean scrap is accompanied by quality certificates right from the source, in order to be used as such, without previous metallurgical preparation.

Because of this and for conomic reasons raw material acceptance has a peculiar importance in of non - ferrous metallurgy which process non - ferrous scrap metal.

Raw material control differs from one group to another according to requirements, the determination being made either only for the metal content, or for the content of all the useful metals.

Correct medium sampling represents the most difficult task of control. Analysis errors in laboratory organization and equipping are excluded.

For this reason, the order and the methods for taking the representative sample were established in some countries by state regulations.

After sampling, old metals and scrap are forcibly discharged into containers to avoid mixing possibilities. These containers are used to carry old metal or scrap along the process flow of metallurgical processing. If such containers are not available, paved platforms must be used and in the case of certain Scrap, should be covered to avoid the possibility of mixing loss by handling and by oxidization.

For these reasons, the use of containers for the transport of scrap is considered peculiarly essential.

In this respect the works "Neferal" in Roumania are well organized with modern equipment for quick qualitative and quantitative analyses, facilities being available for taking representative samples from non-homogenous raw materials (impurified cuttings and oxidic scrap). The works are also provided with containers for transport and for storage after sorting.

The way in which the stages for reception, acceptance, primary processing and batch prepration for melting, are organized and equipped, determine the economic efficiency of secondary non-ferrous metallurgical works. Due to the good organization of these activities, the works continue to increase their economic efficiency by increasing the yields of usable metals and by lowering the processing costs.

At the works " Neferal " the raw materials are classified by using precise methods for obtaining samples, and by using the metallurgical laboratory to analyse these samples. Adequate storage exists for materials processed in the "primary processing" lines.

Aplication of"spectral analyses" for sorting raw rials and for the quality control of semifinished products leads to undespisted improvements the technological process.

Modern technology for processing non - ferrous scrap metals and old metals requires laboratories for metalurgical control and spectral analyses, properly-equipped and organized improved for the complex job of producing the metals from the raw material.

Under our conditions, special importance is given analytical control of the raw material, since the standards of quality provide for the same technical conditions for secondary alloys as for primary alloys, that is, very low maximum values of the impurities.

All samples sent from the collecting centres are separately stored in containers. Each batch is given an order number and a sample for analysis is immediately taken by the person responsible for acceptance in the current shift.

In the case of cuttings, sampling is carried out by forming a medium reduced sample from chips by collecting the succesive automatic extraction of representative portions from the conveyor belts.

The analysis is carried out chemically and spectrally. The fat and moisture content, iron as a mechanical impurity, the alloyng elements (Cu., Sn., Pb.) and Fe. as a chemical impurity are determined chemically. The aluminium content is determined spectrally by a rapid method perfected in our works, on the ISP 28 spectrograph ; the sample subject to spectral analysis being brought as a solution.

According to the analytic results, the batches of cuttings are guided towards the iron removal and the degreasing sections, where they are grouped on assortments, being used afterwards for preparing the batch with a composition which is the closest to that of the alloy provided in the standard.

For cinders and slag acceptance, the lots brought from the collecting centres are given an order number and the operator responsible in the respective shift takes a medium sample by reducing to 50 kg the lot received, by succesive automatic extraction of representative samples from the belts conveying the material.

The quantity obtaind in this way is weighed, then melted in a furnace in a graphite crucible, using soda ash and cryolith for melting. The resulting products are weighed and analysed to determine the metal content.

In conclusion, the building for the copper and secondary copper alloys is characteristic, about 2/3 of the area of the hall is intended for raw material acceptance and storage as well as for its primary preparation. The proper organization of raw material acceptanee is also characteristic, and it is essential to the technical and economic operation of the process.

III. PREPARATION OF OLD METALS AND SCRAP FOR MELTING AND RECLAMATION

Proper preparation is vital prior to melting, which is the next stage.

Adequate preparation ensures utilisation of all the useful elements in non - ferrous scrap metal and old metals.

Application of modern methods of preparation ensures extraction yields, and a lowering of fuel, flux and electric power consumption.

Melting of impure scrap metal always requires expensive refining processes, leading to high processing costs and high losses or useful metal.

Preparation of non - ferrous old metal and scrap metal is achieved by using technologies specific to each group, that is : old metal and scrap metal in pieces, cuttings and in oxidic wastes.

1.- Preparation of aluminium - copper old metal and scrap aluminium - copper in pieces is based on well established procedures. Modern apparatuses, modern equipment, have been introduced in most countries, but the basic operation of "sorting" depends upon man's skill and experience.

The main stages of preparation of old metal and scrap metal in pieces are :

a)- Pyrotechnical control ;

b)- Dismantling and gauging ;

c)- Sorting .

These operations are carried out as required either in the preparation units of the collecting organization, or within the metallurgical plant.

Pyrotechnical control : is carried out by methods specific to this activity, to make safe old metal and scrap metal of military origin.

Pyrotechnical contr l is compulsory for all non - ferrous old metal and scrap metal in order to prevent possible explosion. Thus old metal and scrap metal, with closed ends such as containers flattened or bent tubes, spirals,etc, in which water, acids,etc, can be occluded and can explode when heated, must be controlled. All these types of scrap must be accompanied by a certificate atesting that pyrotechnical control has been carried out.

Dismantling and gauging are achieved by various methods equipment and apparatures, specific or common to some categories of metals and alloys. Dismantling is achieved by the following methods :

- breaking by explosion (dynamiting) ;

- breaking by impact (using a ram, pneumatic hammers or presses);

- cutting by mechanical means, electric cutting, oxyacetylene cutting, gasoline lamp, alligator shear, guillotine, etc.

- breaking down by locksmith's methods.

Gauging can also be achieved by the baling method.

A most modern and rapid melting method recently inaugurated with considerable success especially for copper and copper alloys, is ray cutting by laser beam.

The above mentioned methods are used for alloys based on copper, aluminium and zinc.

Metal cutting is carried out with various apparatuses.

For example : copper cutting is carried out electrically using an electrogenic group. The intensity current is more than 12oo A and modern electrodes are used.

Current intensity and electrodes diameter are directly proportional to the thickness of the part to be cut.

The "las r beam" solves the problem of cutting copper and its alloys.

Cutting of aluminium and of its alloys is achieved using equipment working with a mixture of oxygen and kerosene (oil) or metan gas.

When these methods are used, one should check carefuly to ensure that these are no traces of various fuels in the cut parts, nor are there points on the surfaces which will emanate toxic gases when subjected to hot cutting /ex.the body of supersonic airplanes/.

One of the above methods is applied to each category of scrap according to shape and size, taking also into account its intended use. These methods are common for old metal and scrap metal in pieces of copper, aluminium, zinc and their alloys which is why they have not been dealt with separately.

The basic activity in the process for the preparation of non - ferrous old metals and metal scrap is sorting.

Sorting is the decisive operation for obtaining clean raw materials, which can be melted in a single stage, in an effort to obtain an alloy, with a uniform composition .

Despite available modern apparatus such as spectral apparatuses for halfquantitative analysis, the best method for sorting remains the visual method based on the experience of the sorting staff; using the styloscope having a very low productivity.

That is why we consider that the endeavours made in the last years in the countries of CEMA (The Commission for Economic Mutual Aid)to introduce a system of numbering parts during their manufacture, is especially valuable. The utilisation of old metal could be thus greatly increased, in the future. Sorting is based on physical properties of metals and alloys, such as: colour, the type of fracture, the crystalizing system, magnetic properties, hardness, elasticity, etc.

The experienced sorter works according to the part configuration as well, taking into account the existing standardizing system.

Sorting is carried out on sorting belts or sorting tables.

To determine the composition of parts that are not visually identified, the styloscope is used for the halfquantitative analysis by comparing the spectral lines of the analysed alloy with that of the standard alloy.On introducing the modern spectral analysis methods, the drop analysis method was completely abandoned.

As is well known, methods for sorting non-ferrous old metals and scrap metal have not developed generally, but have been improved by modern equipment.

Considerable progress has been made in sorting old aluminium metal and scrap metal, and aluminium- containing alloys, by applying the method of sorting in dense media.

Until now, this technology was used on an industrial scale in only a few works in Western countries.

The meth d is particularly productive and the only one which eliminates the unproductive hand-sorting system which sometimes lacks precision.

This method consists of crushing parts in a large crusher provided with a safety trap so that parts which cannot be ground are discharged; densimetric separation of maximum 300 mm crushed parts in dense liquids consisting of ferosilicon and magnetic iron oxide suspensions.

There group are obtained mainly :

- with density up to 3,1 consisting of Al.alloys with zinc, copper, mercury, lead, iron high contents ;

- with density between 2,75 - 3, o Al-Cu and Al-Cu-Zn alloys ; -with density below 2,75, Al-Mg alloys or pure aluminium.

2.- Preparation of Aluminium and Copper Cuttings

This is achieved in most Works by applying classic technology, comprising the following stages :

a)- crushing ;

b)- degreasing and drying by centrifusion and by drying in a rotary kiln ;

c)- electromagnetic removal of iron ;

d)- briquetting.

The technology is common both for cuttings based on copper and for those based on aluminium.

Elimination of oils is necessary, since by melting cuttings with oils, most of the metal will be oxidised, and the resulting metal will be enriched with gases or made spongy.

Degreasing and drying are necessary for the magnetic removal of iron which exists in the mixture carried over mechanically. Also they are necessary as a labour protection measure.

The extraction yelds currently obtained by melting aluminium dry cuttings are 9o - 92% and in the case of melting unprepared cuttings the yelds obtained does not exced 68-7o%. Experience at the plant " Neferal " of experiments with brass and bronze cuttings proved that poor preparation can lower yield, to 1o-15%. This proves that melting of cuttings without previous preparation is not advisable, more so with aluminium cuttings. It is recommended to dry them imediately after their formation and store in covered rooms. Aluminium cuttings with 12% moisture content if kept for 8 months show approximately a 37% lowering of the extraction yield after processing.

Degreasing is partially achieved by centrifusion in the case of aluminium cuttings. But this operation is economic only for cuttings with an oil content of more than 6%. After centrifusion the content lowers to 1,5-2%. A lower content is obtained (o,5%) by repeating centrifusion and by using superheated steam. Various solvents may be added such as dichlorethane and trichlorethane. Degreasing and drying in the rotary kiln is applied directly for aluminium cuttings or with previous centrifusion. Centrifusion is not applied to copper, bronze and brass cuttings.

Although roasting in rotary furnaces is a recent process, it is quite troublesome. Burning of oils and emulsions in furnaces leads to a temperature of 8oo-9oo°C., a temperature at which about 3-4% of the cuttings are oxidized. By rotating the furnace, some of the cuttings are broken up by friction, lowering in this way the extraction yield at melting.

During roasting a large amount of gas is liberated.

At the plant " Neferal ", this technology is used for preparing copper, bronze and brass cuttings with all the troubles mentioned above, specifying that centrifusion and briquetting are not done gases were previously burned in an after burning chamber and afterwards this instalation was replaced by an original installation comprising a fractionating and condensing column and a system for reducing explosive risks. This instalation is much simpler and more economic, and the eliminated gases are much cleaner.

By the electromagnetic removal of the iron, using an electromagnet with drums, the iron content in bronzes and brasses is reduced to about 0,4%, and is therefore within the limits provided by the standards. For this reason the removal of iron by heating accompanied by considerable loss of useful metal is no longer necessary.

We would mention that the instalation is completely automatic (that is feeding, temperature adjustment in the roasting furnace, synchronizing of the running of the whole assembly).

Despite the shortcomings this preparation technology the extraction yields at the melting stage are up to 10-20% higher than in the case of melting unprepared cuttings.

Nevertheless we consider that it is necessary to replace as quickly as possible the drying - roasting method in rotary furnaces, by the chemical degreasing method.

American publications describe the operation of some degreasing installations for the preparation of copper cuttings and for the preparation of aluminium cuttings and also their alloys.

In these installations, cuttings are introduced into boiling solvents. In a short time one obtains an almost complete degreasing. Cuttings require no drying, as the temperature is so high that they dry immediately.

Whilst achieving degreasing these solvents do not act on oil. Whilst collects on the surface of the bath and can be removed, so that the solution can be reused several times.

In view of the necessity to reclaim large amounts of non- ferrous metals, research in this field should be intensified.

In some countries attempts at degreasing by means of ultrasounds have been carried out. Results are promising, but have not yet been applied on an industrial scale.

Briquetting of cuttings is carried out in order to facilitate handling and storage. In some cases there is a growth of the extraction yield at melting. Briquetted aluminium cuttings behave well only if briquetting is carried out with freshly obtained cuttings. With old ones because of the film formed on the cutting surfaces, briquetting hinders the melting process through a decrease in conduction.

Although many processes have been developed, the high operating costs are not always justified by the possible increase of the extraction yield. Within the " Neferal " plant the experiments carried out in the industrial stage with brass and bronze cuttings proved non-efficient and therefore disproved this method of melting in electric furnaces. The increase of the average time for batch preparation was by 25-35' higher that for briquettes melting, and the extraction yield lowered by about 4%.

In order to obtain briquettes with a higher specific weight to facilitate immersion in the bath it was desirable to use presses of high capacity and eventually to heat the cuttings to the limit of plasticity, forwhich however equipments are not manufactured.

In conclusion, we consider that briquetting is at present an unprofitable process for melting aluminium or copper cuttings in electric furnaces, where feeding into the furnace is completely mechanized and the melting of un-briquetted cuttings works very well.

3.- Preparation of lead waste and scrap of lead based alloys

The operations for primary processing of old metal and scrap containing lead are generally simple. They are achieved by specific cuttings, dismantling and sorting methods.

In applying the technology for primary processing of lead scrap the aim is to obtain a raw material with as low an impurity content as possible.

Thus, the duration of some refining stages is reduced eliminated, lowering also the metal loss.

Another aim is to obtain directly an alloy the composition of which is very close to that of the end alloy, or to obtain some prealloys in which useful elements such as tin and lead concentrated. These prealloys are used subsequently for obtaining some antifriction alloys or printing alloys.

Primary processing of old metal and scrap is done according to well proved methods for each type of scrap, thus:

- Sheet and tube rolled products, old metals and scrap processing is done by cutting for gauging. Tubes are cut no matter what size they are, and are flattened and bent thus applying pyrotechnical control and eliminating the possibilities of water or sludge content characteristic of chemical plants which in contact with the melting bath can cause serious accidents by splashing workers with molten metal.

- Processing of lead-sheathed cable scrap is usually done at the processing units of the enterprise for metal collecting, because of difficulty of transport. These well-equipped units use special devices. First of all, the cable is cut into 1,5 m long pieces by means of an aligator type shear or a guillotine. The iron-armouring is then removed and the jute insulation is removed, The lead sheath is longitudinally cut with a mechanical saw. The last operation is the removal of the paper insulation from the copper or aluminium wires.

In recent years some countries have accomplished these operations on special equipment for cables dismantling.

This type of equipment is highly productive utilising a continuous process resulting in good quality products.

Some methods of melting the lead sheath and burning the insulations are completely contra-indicated. Melting of lead by burning the insulation in special furnaces results in great losses of lead and by the impurification of copper wire with lead. Contamination with lead makes the copper wire useless for the fabrication of high quality alloys.

- Processing of lead from bullets is carried out by melting them in vessels at a temperature of 400°C. The extraction yield of hard lead is about 80%.

- Lead parts are dismantled and carefully sorted. Cutting is done by known methods such as shear or guillotine. Sorting is done by the hardness or bending test. All the parts are pyrotechnically controlled after dismantling.

4.- Preparation of Oxidic Wastes

Preparation of Accumulators Waste

In recent years in order to obtain as high extraction yields as possible, several processing methods have been tested.

Research has proved that some stages of primary processing are essential.

Primary processing methods vary as a function of the furnaces in which scrap melting is going to take place. Specialists of various countries argue about the superiority of some methods over others.

Worn out accumulator batteries pass first of all through the dismantling stage which consists of remowing the plates from the ebonite box, washing them with water in order to remove the acid, separation from the plastic separators, and cutting of bridges and of copper contacts or brass muffles.

The sludge residue in the boxes is collected seprately and dried to facilitate transport.

These operations are carried out the Scrap Collecting Works, which provides all necessary measures for labour protection to eliminate the danger of spraying with acids during the dismantling stage.

The preparation process produces the folowing material:

- accumulator plates ;
- sludge and a part of the shaken paste ;
- bridges ;
- copper contacts.

All these are stored seprately and delivered to the works for processing secondary non-ferrous metals.

Some specialists recommend the separation of the goids from the lead paste, and to wash these with soda after shaking, in order to remove sulphur as a sulphate thus obtaining a raw material which is useful for the production of lead and so wich can be used for accumulator fabrication.

The lead paste is processed only in works where the problem of collecting volatile dust has been solved.

Recently more and more specialists have advocated the careful processing of accumulator wastes, thus obtaining a high extraction yield which offsets the extra costs of primary processing.

In some countries special installations exist for the following operations:

- breaking down of worn out accumulators and accumulators wastes ;
- washing the crushed products so as to separate a rough metal part consisting of more than 96% metal ;
- separating the sludge, then filtering and thickening resulting in a deposit with above 70% metal content;
- separating the ebonite wastes and plastic wastes, leading to a fraction with less than 0,4% lead content.

In Roumania accumulators are dismantled in the Metal Collecting Works and then are delivered to secondary non-ferrous metallurgy works in the separate forms already mentioned, that is : scrap plates, sludges and sometimes bridges.

The wastes of accumulator plates are melted together in order to obtain an accumulator alloy, which after removing the fine copper paste is required for the manufacture of new accumulators. Because of possible contamination at the storing units or during transport they sometimes also require tin refining

Bridges are used after separating copper contacts and brass parts to obtain technical lead.

Sludges are briquetted or pelletized to reduce melting losses.

In these days when the processing of accumulator wastes at the melting stages accompanied by the liberation of noxious gases which could endanger health, we consider that careful primary processing by previous sorting and blending and by wet grinding is a vital necessity in addition to the economic consideration which matters are still discussed by specialists.

However, this type of processing creates conditions for the automation of furnace charging operations and for process remote control, and therefore necessitates protection measures against noxious gases.

In conclusion, in order to increase extraction yields by inproved methods, as to ensure safe working conditions, it is necessary to pass the accumulator waste through the washing, neutralization and grinding stages, and even to separately the small fractions.

In this respect several experiments have been carried out in Roumania, with good results.

Preparation of Lead Cinders and Slag

Lead cinders and slag, and those which contain tin, antimony, including sludges from the accumulator batteries, are processed either separately or mixed, according to their composition and to the amounts available.

These lead cinders are them passed through the screening stage to isolate the small fraction below 10-12 mm, which are subjected to the aglomeration, briquetting or pelletizing process. These cinders, together with pieces bigger than 10 mm are then melted in the water-jacket type shaft furnaces, in electric furnace, with electrodes, or in the rotary furnace.

We consider that the agglomeration process, still prevalent in some countries, will be replaced by the briquetting process because aglomeration of lead cinders is used for sulphur sintering, but not also for roasting.

The briquetting process has no lead and tin losses due to volatilization, and there is no danger of lead melting at stage.

Another advantage of briquetting is that it requires no expensive installations, thus production costs are much lower.

Aglomeration takes place on tables or on belts. The process is simple and involves only cinders sintering which is accomplished by burning the coke dust introduced into the batch. The aglomeration process develops well when the batch contains 35-40% lead. Increase of the lead content increases dificulties due to melting of part of the lead content. Therefore rich cinders are mixed with the necessary flux and also with poorer cinders,or with the granulated slag, from melting. Average productivity of the aglomeratied aggregates is about 20 to batch/m^2/24 h. Lead extraction in the agglomerate is 97%, and that of antimony 94%.

So,one notices that already at this stage of lead and tin reclamation a large amount of metal is lost.

Briquetting of lead and copper cinders was studied and effected in the plant " Neferal " in Roumania. The process consists of briquetting cinders with a binder (in this case bitumen) by means of a briquetting press. The briquettes obtained are subjected to a drying-oxidising process. Briquettes have a very high mechanical resistance(150-160 kg/cm^2), and behave well in the melting process.

In the case of briquetting cinders which contain accumulator sludges, it is recommended to neutralize the sulphuric acid content by adding lime dust. Since without neutralization, briquettes will pulverise during the melting process.

Both copper and lead volatile dusts are pelletized as this is the most economic preparation process.

At " Neferal ", pelletizing is achieved with lime slurry and subsequently dried. Pellets have an adequate mechanical strength.

In conclusion, we consider that the future trend in primary processing of lead and copper cinders and slag will be the replacement of the agglomeration process by the briquetting process. Even the pelletizing process may be introduced, as it is very economical for very small fractions such as volatile dusts.

Preparation of Copper Cinders and Slag

Copper oxidic wastes are prepared for melting, using the same metals and equipment as for the preparation of lead oxidic wastes, which is why we shall not consider them separately.

The preparation methods in view of their agglomeratior are :

a)- agglomeration on tables or belts ;

b)- briquetting ;

c)- pelletizing.

Only the first two processes are practiced. Pelletizing of cinders is theoretically possible, but it has been demonstrated that pellets do not provide the desired characteristics.

Although some publications claim that the briquetting process is less productive and less efficient, we consider that in the processing of copper oxidic wastes in smaller countries such as Roumania, the use of the briquetting process has proved increasing efficient when compared with the agglomeration process.

At " Neferal " the briquetting process takes place in a similar installation to that used for briquetting lead oxidic wastes, changing the briquettes composition and the drying oxidation parameters.

- Preparation of Aluminium Cinders

These cinders are prepared in a cylindrical sieve with continous feed and various types of mills for grinding the agglomerated part.

The small particles (below 3 mm) pass through the meshes of the sieve and are used as a saw material for various purposes.

The rough part, especially the lumps are after being ground during rotation, screened to obtain the small particles which are especially used to produce zinc sulphate, the sieve rejection, which represents the metal part (the metal carried over the crust) impurified with iron pieces and other alloys is less fusible. Sieve rejection is sorted and sent to the melting process. Thus, about 60% of the aluminium metal existing in the crusts can be reclaimed and the rest by extraction in the chemical process.

IV. PROCESSING OF OLD METAL AND SCRAP CONTAINING COPPER AND ALUMINIUM, WHICH REQUIRE SPECIAL TREATMENT

Preparation of Insulated Old Wires

Mechanical dismantling of power cables in general presents no problems. Preparation of insulated and mixed old wires is a more difficult industrial problem which is as yet unsolved.

Scrap comprising insulated wires contains copper of the highest quality. As the copper wire is protected its quality remains unchanged until dismantling and preparation for melting.

All the roasting methods (insulation burning) lead to copper degradation so that when melted, copper must be passed through the refining stages. These operations besides being associated with high processing costs also result in copper losses of 3,5-5%.

A modern method for separating the insulation from the copper is by cutting the insulated wire in 25 mm pieces and by separating the lighter part by means of compressed air.

This method can be applied only for wire insulated with P.V.C. and paper.

The respective method cannot be applied to other types of insulated wires, such as for instance those insulated with cotton and covered with a lead sheath. That is it cannot be applied to those types where the insulation adheres to the copper wire and does not come off when cutting.

Difficulties arise mixed wires containing old wires. Experiments with mixed wires to find general methods for the separation of all types of insulating materials, showed the necesity of applying a system based on :

- cutting of wires in 15-25 mm pieces ;
- treating with a 5-15 NaOH solution ;

This solution dissolves bitumen and the fat substances with which they are impregnated, and separates the paper and cotton insulation .

- the small parts, treated in this way, are passed through a magnetic separation for removal of the iron ;
- the insulation is removed by means separating in heavy liquids :

a)- with 1,75-gr/cm^3 specific weight for insulation separation ;

b) with 3 gr/cm^3 specific weight for aluminium separation ;

The concentrated copper metal slurry from which lead is separated, is dried, briquetted, and sent for melting.

Copper obtained by this method may contain tin from tin coated wires and lead from lead covered ends and other elements with which the scrap is contaminated. Analysis has shown that one can obtain a material with 99,5-99,8% copper, which can be used directly without further treatment for producing copper alloys. Comparatively, from the same scrap a content of only 98,8% copper resulted from roasting insulated wires.

When cables have a steel core, as well as insulation , as in the case with aluminium cables, separation is carried out by means of a special bench for with-drawing the core.

Processing of Bimetal Scrap

Copper-iron bimetal scrap is usually processed pyrometallurgically by charging into the shaft furnace. Present techniques use great amounts of bimetal with very thin copper layers. Their processing in the batches of shaft furnaces is not recommended since copper oxidic wastes or lead-copper concentrates are melted.

Chemical or electrochemical separation of the copper or tombac layer is advisable.

Scrap cast aluminium-iron bimetal bushing can be separated by heating. Taking into account the different heat, conductivity coefficient, the two metals separate easily. This method cannot be applied to separate the aluminium-steel bimetal obtained by rolling. Scrap of this type has not yet been usefully utilised.

Preparation of Scrap Radiators for Melting

This operation is done by heating the radiators to the melting temperature of the alloy used for soldering the brass sheet, which forms the honeycomb of the radiator.

Melting is done in grate furnaces which collect the Pb-Sn alloy used in the fabrication of Pb-Sn alloys, and the brass sheet is melted to obtain copper alloys with lead, tin and zinc content.

Old Metal and Scrap from Electronic Equipment

Their sorting is a particularly difficult operation. Usually, one tries to remove the copper wire, the coils, the screened cables, the condensers, the resistors, etc. When aluminium foil waste is required in rolls, it is melted as such. Small pieces must be first briquetted.

Melting of oil entails high loss of aluminium, due to the large oxidisation surfaces. Nor does baling solve the problem of loss under optimum conditions. Melting of paper backed aluminium foil is not advisable.

Modern methods involve cutting the paper-backed aluminium foil separating by blowing compressed air. This process is non-efficient and non-productive.

The proved method is to heat in a special hermetically closed furnace. After the burning of paper and organic compounds, the foil is easily separated by sieving.

Preparation of old Tin and Zinc Metal and Scrap

The preparation of old tin metal and scrap is achieved by the following methods :

a)- tin is reclaimed from tin-covered sheet scrap by the electrolytical methods.

The process of tin-removal is the subject of another paper so we shall not describe it here.

b)- tin metal and scrap is usually prepared like lead scrap for obtaining Pb and Sn alloys.

Preparation of old zinc metals and wasts in done by sorting in order to obtain zinc and zinc alloys without mechanical impurities. Such products are used as raw material for zinc oxide production. Only zinc sheet or printing blocks can be used for brass fabrication.

Zinc cinders and volatile dusts are pelletized to facilitate introduction into process for extraction. Volatile dusts and zinc cinders are separated according to granulation with a view to using the small sizes, in the paint industry, the medium sized fractions as raw material for zinc sulphate, and the remainder for zinc metallurgical extraction.

This paper attempts to present the prevailing situation and the developing trends for techniques for preparing non - ferrous old metals and scrap metal.

It has been noted that adequate preparation prior to melting improves the quality of scrap which can be used directly in the preparation of end products without intermediate melting and heat refining operations, which entail metal loss and supplementary costs.

Parallel with the application of modern technologies physical - chemical methods for quick analysis have been introduced which further technical progress in this field. Thus increased efficiency has evolved in selecting the components for the batch, an operation which passes from art to science by introducing efficient methods based on mathematical calculations which have been carried out by electric calculators.

The provisions concerning the preparing process and the preparation methods are vital for the full reclamation of non - ferrous old metal and scrap.

The efficiency of reclamation, and ultimately the rational utilization of non - ferrous metal, is dependant upon the good organization of these activities, and the provision of adequate technologies and installations for preparation.

These show also the special importance of scrap reclamation to developing countries. These countries are able to organise efficiently collection and preparation of old metal and scrap, simultaneously with the growth of their industries.

It is also necessary to organise efficient reclamation as new types of scrap appear.

Therefore, it is important for new technology designs that will provide scrap, to suggest means for its reclamation.

Concerning the introduction of new types of alloys, we consider that it is important to provide instructions for a rational utilization of resulting scrap as well the quality standards, work instructions, and process rules.

In this way, the national economy will benefit from efficient use of non - ferrous materials.

- S U M M A R Y -

The paper deals with sources of old non - ferrous metal and scrap, and the importance of their being understood.

It is particularly important to know the sources of old metal and scrap, their origin and classification, in order to ensure adequate storage and transport from their collecting place.

The fullest reclamation of all useful metals from old metal and scrap can be achieved only by complete utilization of scrap in order to obtain end products as like as possible to the raw material. This result may be achieved only by preparation of old metal and scrap right from the source, always allowing for the necessities of the processing plant.

Methods of increasing extraction yields economically is ensured by :

a)- Knowledge of source and composition of old metal and scrap ;

b)- Classification of old metal and scrap in accordance with quality standards. This proves the importance of compulsory standards for their classification. When a standard for non - ferrous scrap is conceived one must consider the quality requirements demanded by the processing plant ;

c)- Provision connected with acceptance, discharge, transport and storage, in order to avoid any possible contamination.

d)- The organization of enterprises for collection and delivery of old metal and scrap to the processing plants ensuring

quality requirements.

e)- The organization of preparing lines of old metal and scrap to ensure quality requirements for full reclamation of useful metals.

Some of these provisions are confined to the source of scrap, some to the collecting enterprise and others to the processing plant.

Advanced preparation is usually achieved by specialised plants that provide more complex installations.

The paper shows what type of scrap is collected in Roumania and what are the preparing phases provided by collecting enterprises and specialised plants for scrap processing.

Also noted is the particularly importance of raw material acceptance at scrap processing plant.

A characterisation of each category of old metal and scrap is made as follows :

- copper and copper alloys ;
- zinc and zinc alloys ;
- tin and tin alloys ;
- lead and lead alloys ;
- aluminium and aluminium alloys.

The characteristics of old metal and scrap are presented in three groups :

- old metal and scrap in pieces ;
- cuttings ;
- oxide scrap.

The preparation of old metal and scrap for melting and reclamation is the true theme of the paper and therefore the preparation shedule is presented in detail in terms of base metal.

The author presents the preparing technologies with process-flow diagram now applied and at the same time presents future tendencies in this filed.

He has described the preparing experience of "Neferal" works - specialised for scrap processing, and the efficiency of used technologies, comparative with world experience.

The preparation of old metal and scrap of aluminium-based and copper - based alloys is achieved by pyrotechnical control, sorting, dismantling and baling. For this, specific equipment is used.

The preparation of cuttings of aluminium - based and copper - based alloys is achieved by the following schedule : breaking up , degreasing , iron - removal and briquetting.

Due to deficiencies in degreasing technologies using rotary drums, modern methods of degreasing with solvents have been tested.

The preparation of lead and lead alloys scrap, is achieved by using specific equipments for power cable dismantling and for tubes.

The preparation of oxide scrap containing copper and lead is accomplished by aglomeration or briquetting.

The preparation of oxide scrap containing aluminium is done by mechanical or hidromechanical technologies.

The preparation of battery waste is usually achieved by dismantling and sorting, but in some countries special installations exist for the operation such as breaking, washing and separating.

The preparation of old metal and scrap containing copper or aluminium, which requires special treatment , is made by specific methods.

Parallel with the application of modern technologies, physical - chemical methods for quick analysis have been introduced.

In conclusion, it has been noted that the previous provisions connected with rational primary preparation and modern methods of preparation are vital for an economic reclamation of non - ferrous metals.

The importance of these activities ind developing countries has also been pointed out.

Developing countries are easily able to organise simultaneously with developing industry the collection and pre - paration of old metal and scrap.

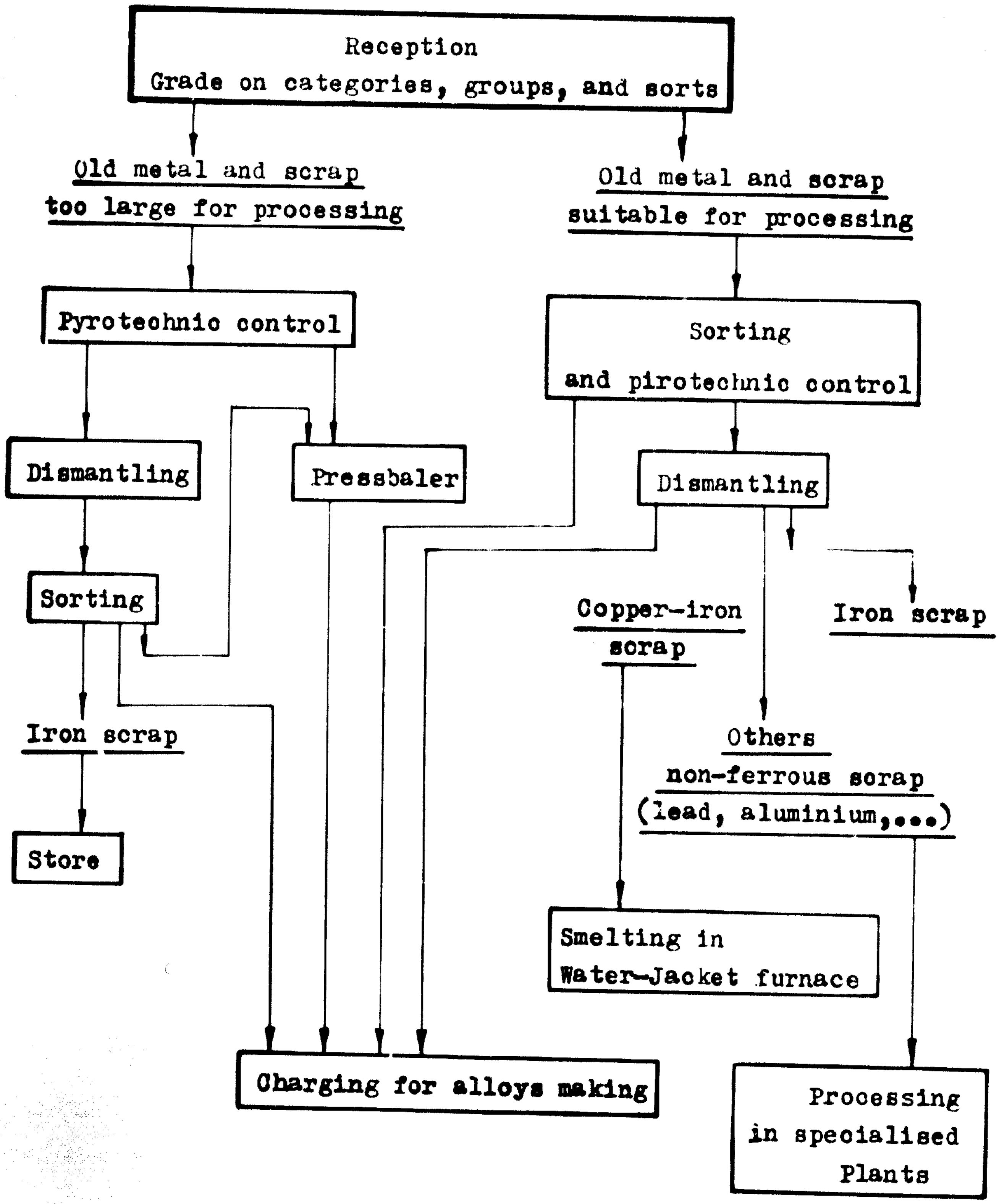
Knowledge of the source of old metal and scrap, and the application of modern technologies for their preparation , provide all the necessary requirements for a full reclamation of non - ferrous metals.

APPENDICES

PROCESS FLOW DIAGRAM

PRETREATMENT OF SCRAP OF COPPER BASE ALLOYS

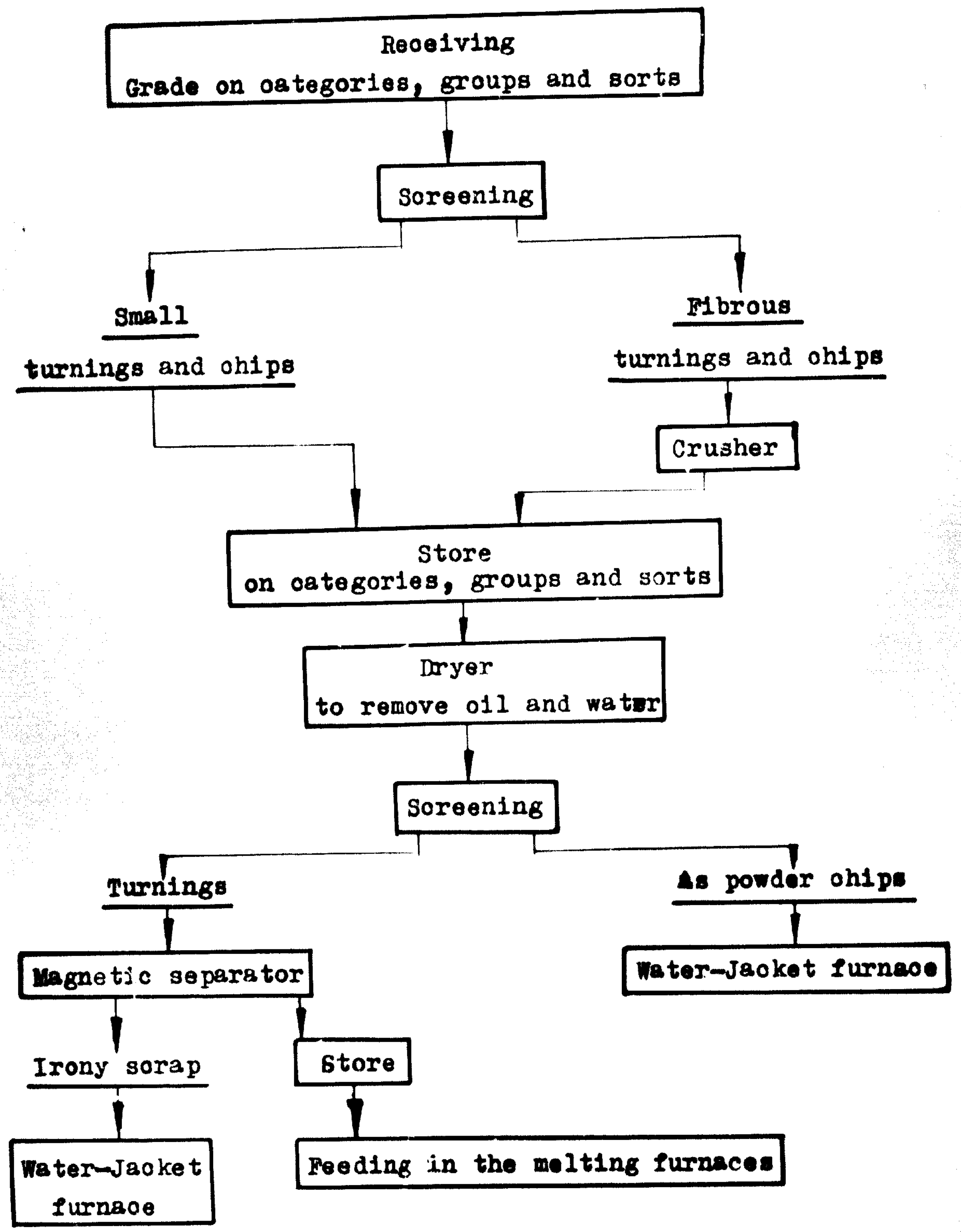
USED IN ROUMANIAN WORKS



PROCESS FLOW DIAGRAM

PRETREATMENT OF TURNINGS AND CHIPS OF COPPER BASE ALLOYS

USED IN ROUMANIAN PLANTS



PROCESS FLOW DIAGRAM
PRETREATMENT OF COPPER AND LEAD DROSS AND ASHES