NON-FERROUS METALS AND ALLOYS: TECHNICAL ANALYZE METHODS

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Abstract

The non-ferrous metals and alloys suffered important changes during the last years in the industrial processes concerning the liquid state treatment before casting. The target in the management of the industrial process is to the melting process, alloying kinetic of nonferrous metals to increase the melting efficiency and diminution of energetic consumptions and metal losses. We have complex processes, physicochemical phenomena at melting, alloying, refining and modification of metals and alloys and we need to choose a good method for macro and micro analyze started of the purer non-ferrous metal to the alloy. We define the analyze object and we must choose the analytical method and target a lot of factors like: the concentration field, the precision, the sensitivity, the selectivity and the rapidity.

This paper presents the general aspects of the qualitative analyze of the cations and anions from the non-ferrous metals and alloys and also the aspects of the quantitative analyze. We described the gravymetrique, volumetrique, optical and electrical methods for micro technical analyzed.

Keywords: non-ferrous alloys, quantitative analyzed, qualitative analyzed, methods

1. GENERAL PRINCIPLES

The melting and alloying of non-ferrous metals performs industrially in open furnaces, at atmosphere aggregates in atmospheric pressure (common alloys - Al, Cu, Zn, Pb, Sn and Ni alloys) or in vacuum or inert gas (reactive alloys - Ti, Zr, Mo, W, Nb and Ta alloys) [1].

The quality of alloys and their physical-mechanical processes properties depend on the wright’s composition and the purity of the material.

Although precautions were taken in casting process of liquid alloys, these always contain a certain amount of metallic impurities, gases and inclusions. These melts cannot be used to filling of moulds without a previous purification (refining) because ingots and castings with low mechanical and technological properties would be obtained.

What includes the metallic melt refining? This includes the elimination of the impurities, the inclusions and the gases.

That's we need to choose a good method for macro and micro analyze started of the purer non-ferrous metal to the alloy.

We use analytical methods in fact chemical and instrumental methods.

In general these methods measure the volume or the mass.

The instrumental methods involved are electronically or optical or thermo equipment.

The best results of the analytical method are to use both methods: chemical and instrumental techniques [2]
2. GRAVIMETRICAL METHODS

The gravimetric is an analytical quantitative process which is based on the weight of analyzed substance obtained by the precipitation technique, electrodepositing or after a volatility process.

The operations which are necessary to obtain a pure probe by the precipitation are:

- the precipitation of the desired constituent;
- the filtration;
- the dried;
- the weight of the precipitation.

One example is the quantitative precipitation of the chloral ionic with the silver cation.

\[ \text{Ag}^+ + \text{Cl}^- \rightarrow \text{AgCl}(s) \]  

We stay a period for produce the reaction and after that we make the other operations (the filtration, the wash, the drying).

Finally we weight the silver chloride and we count the quantity of chloride or silver ions which we have in product.

In the situation of the electrodepositing, the desired constituent is isolated on an electrode in the time of the electrical current is passing.

The difference between the initial and the final weight of the electrode in the time of galvanization covered represents the quantity of the constituent.

The volatility has the same features with the electrodepositing process because we have also a difference of weight.

In this case, the probe is decomposed by a reaction in which one of the products is volatilized. In general, the loosed of the weight is because one substance is decomposed.

\[ \text{CaCO}_3(s) \rightarrow \text{CaO}(s) + \text{CO}_2(g) \]  

We have also the possibility to loose the volatile substance from the probe composition:

\[ \text{KCl} \cdot \text{XH}_2\text{O}(s) \rightarrow \text{KCl}(s) + \text{XH}_2\text{O}(g) \]  

3. VOLUMETRIC METHODS

The volumetric methods include the proceeding based by the volumes measured of a reactive solution or gas which we know the concentration.

We add in the probe in a right proportion, which is in fact the reflex ion of the chemical reaction. The process is named titration. The solution name is titrant. All the time we need a moment in which the equilibrium of the reaction is perfect for the detection of the point in which the reaction is complete.

We need a standard solution and of this base we can calculate the quantity of the reactant from our probe.

There are for kind of volumetrically titrations in function of the reaction type:

1) acid-base titration;
2) oxidant – reduce titration;
3) precipitation titration;
4) chelatometrical titration (complexonometrically).

The first one is a neutralization reaction. In this case the acid is determinate by the titration with a standard solution of an acid. The standard example, HCl may be titrant for a NaOH probe or vice versa.
The basically reaction is:

\[ \text{H}_3\text{O}^+ + \text{Cl}^- + \text{Na}^+ + \text{OH}^- \rightarrow \text{Na}^+ + \text{Cl}^- + 2\text{H}_2\text{O} \] (4)

We have the possibility to make a titration of acid-base type in a solvent (not water). The result is correct in the case we use the right solvent.

For an oxidant – reducer titration we change the oxidation of the determinate substance and also of the titrate reactive.

The classical example is the iron solution with a usually dichromate:

\[ 6\text{Fe}^{2+} + 2\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ \rightarrow 6\text{Fe}^{3+} + 2\text{Cr}^{3+} + 7\text{H}_2\text{O} \] (5)

A precipitation titration is in the same situation with the gravimetric method because we have a precipitate. The difference consist in the fact that we have not an excess quantity. We have the chemical right quantity of precipitation. The precipitation is measured by the necessary volume for reaction. Because the solution of the precipitation substance is calibrated we can calculated the quantity of the constituent.

It’s not a usually method because it’s difficult to find the equivalence point.

In the last, complexonometrical titration, the titrate is an agent of complexation, from the reaction result a complex substance.

An example is the titration of the Cu (II) with the disodique salt of the etilendiaminotetracetique acid (EDTA).

\[ \text{HO}_2\text{C} \times \text{H}_2\text{C} \text{CH}_2\text{COOH} \]

\[ \text{Cu}^{2+} + \text{N-CH}_2\text{CH}_2\text{-N} \rightarrow \text{Cu-EDTA} + 2\text{Na}^+ + 2\text{H}^+ \] (6)

4. **OPTICAL METHODS**

The optical methods are based on the reaction of the probe at the electromagnetique radiation.

The optical propitiations which we correlate with the concentration are: the absorption or the emission of the radiant energy, the diffraction of the radiant energy, the dispersion of the radiant energy and the late emission of the radiant energy.

The building of the necessary apparatus involved the utilization of the lengths, the mirrors, the prisms, etc. The most important methods are: the mass spectroscopy, the nuclear magnetic resonance and the electron reaction resonance.

5. **ELECTRICAL METHODS**

The electrical methods include the utilization of the electrical instruments with the target to measure or to product electrical phenomena. The most important properties are: the electrical flux function of the time, the potential, the capacity of the electrical pass and the resistance. These properties are correlated with the reaction of the substance and produce another reaction.

The concentration depends of the measure of the resistance, the tension, the intensity of the electron flux and the time.

6. **CONCLUSIONS**

A SWOT analyzes for chemical and instrumental methods are made.
Fort points:

Chemical methods:
- The proceedings are simple and precise.
- In general the methods are based on the absolute measurements.
- The equipment used is not expensive.

Instrumental methods:
- The determination is very rapid (under 1/100 s).
- We can use small probes.
- We can research complex probes.
- The method has a high sensitivity.
- The results are sure.

Threats points:

Chemical methods
- Sometime the specificity is missing.
- The time for analyze is long.
- The precision decrease with the quantity of probe.
- It’s doesn’t exist a flexibility.
- It’s a source of pollution for the environment.

Instrumental methods:
- All the time we need an initial calibration of the apparatus.
- The sensitivity and the precision depend of the apparatus or of the chemical method which we utilize for the calibration.
- The final precision is sometime of ± 5%.
- The initial cost for the apparatus equipment is high.
- The concentration interval is limited.
- We usually need a great space.
- We need a specialist and competence of the workers.

LITERATURE