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ECONOMIC AND MANAGERIAL ASPECTS ABOUT ALUMINUM AND ALUMINUM ALLOYS

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Abstract: Worldwide, the industry has experienced a serious aluminum crisis in recent years, which has been reflected in decreased profits of many companies and the decline in equity prices on the stock exchange metal in London. Analyzing balance request-offer in recent years, it appears that the main reason that explains the current situation is the unexpected decline in demand caused by the global economic crisis, as well as surprising and sudden changes in downstream, along with increased supply, generated by China's strategy to expand the production capacity of aluminum. In this article we present you managerial and economic aspects specific to aluminum and aluminum alloys. The starting point for this article are physical and chemical properties of aluminum. We are also making a short presentation of the largest aluminum manufacturer in the world, the American company Alcoa. Economic aspects that can be applied to the obtaining optimization of aluminum and aluminum alloys mainly consist of presenting, describing and analyzing the return threshold method.
Keywords: Aluminum, Economic, Aluminum alloys

1. INTRODUCTION

Because of its high chemical activity, aluminum is found in nature only as compounds. Together with oxygen and silicon, it forms 82,58% of Earth's shell, being concentrated especially close to the surface. Having high affinity to the oxygen in the air, even at regular temperatures, aluminum can easily be covered by an oxide layer, which protects the metal from a subsequent oxidation. The oxidation process of aluminum develops as temperature rises and depends on the concentration of surrounding elements. Table 1 presents the main physical and chemical properties of aluminum

Table 1. Physical and chemical properties of aluminum

Criteria Number	Physical and mechanical properties of elementary aluminum	
1	Atomic number	13
2	Atomic mass	269.815
3	Atomic radius	1.4286A
4	Ionic radius	0.8598A
5	Interatomic distance	2.8630A
6	Boiling temperature	2056°C
7	Melting temperature	660.240°C
8	Casting temperature	710...730°C
9	Processing temperature	350...450°C
10	Re-baking temperature	370...400°C
11	Comeback temperature	150°C
12	Re-crystalisation temperature	150°C

Alcoa is the American company with the highest production level of aluminum in the whole world. Founded in 1888, in Pittsburg, it took the name of Aluminum Co. of America (1907). In 1910, Alcoa started producing aluminum foil for the first time and also found new ways to use aluminum in newly founded industries, like aviation and automobiles. It also founded the city of Alcoa, in the East of Tennessee, as an industrial community (1913). In 1945, a federal ruling obligated the company to sell its Canadian branch (now Alcan Aluminum Ltd., the strongest opponent of Alcoa). In 1998, Alcoa purchased Alumax Inc. The two companies have a total of over 100 000 employees and an annual production of about 4 million tons of aluminum.

2. MANAGERIAL ASPECTS OF ALUMINUM ALLOYS

Considering the diversity of aluminum alloys, in order to classify them we have to consider several criteria, such as:

I. By the technology used to obtain components and finished products

II. By properties and area of use

Non-ferrous alloys, more than ferrous ones, require multiple complex operations. The main particularities of alloying non-ferrous alloys are:

- the large number of alloy elements (from 2-3 to 7-10);
- different content of alloying elements; most alloys have low content (0.52%), but some can have high content
- most alloy elements have high affinity to oxygen at development temperature (Al, Mg, Be); loss of alloying elements through oxidation vary from a melting process to another;

- many alloying elements have a high vapor tension (Zn, Mg, Cd);
- many alloying elements have superior melting temperatures compared to the resulting alloy, for example copper or nickel compared to aluminum alloys; iron, manganese and nickel to copper alloys; copper to tin alloys; manganese to magnesium alloys etc.; under these circumstances, direct alloying is done with difficulty, it requires very high heating and excessive time of elaboration, resulting in errors regarding alloy composition
- some elements, during direct alloying, develop high heat (e.g. aluminum in copper).

The main prime materials used for creating aluminum alloys are:

- metals and new alloys (primary), with different purity ranks, originated from metallurgical extraction from ores, delivered as blocks, bars or boards;
- metals and secondary alloys, ready-made, originated from re-melting metal waste and collected alloys, delivered as blocks, bars or boards;
- foundry waste: casting networks, feeders, shells, drops, chips and scrapings originated from processing parts and ingots, as well as casted parts, ingot heads from plastic processing workshops, board edges, bar heads, waste from punching boards, board waste, etc.
- imported old metals and alloys;
- pre-alloys.

Technological and managerial procedures of aluminum alloy development are considering obtaining a higher energy efficiency, for a more advanced de-oxidation and refinement process that takes less time.

The main physical and chemical phenomena which happen during aluminum alloy development are:

- metal vaporization;
- interactions between metals and gasses;
- interactions between metals and refractory materials;

Alloying aluminum with silicon and copper result in lowering hidrogen solubility. Adding tin and gold lowers solubility as well. Hidrogen solubility rises abruptly during alloying aluminum with metals which form hydrides (Ti, Zr).

Obtaining alloys with precise composition, with a short elaboration time, at minimum heating, with minimum losses through oxidation and minimum gas absorption, requires using certain components and a certain loading order of elements into the furnace.

3. ECONOMIC ASPECTS OF ALUMINUM ALLOY ELABORATION

One of the fundamental questions which you must answer as a financial manager is: How many units of my product/work/service must my firm sell so that it covers the expenses of execution? And, of course, the question which results from the previous one: How many units must I sell so that I obtain the profit demanded by the shareholders? If a correct estimation of these values is not made, the firm can suffer form significant losses and, following that, it risks being sold on the market in a short time.The best way to answer the two questions is using the return threshold method, which represents the production capacity from which you can start to redeem your investment.

The return threshold represents the level of production at which total expenses are equal to collections from selling the product.

The return threshold method

The return threshold method is an important method in product rentability analysis and activity rentability, in the phase of designing new productive capacities, activity prognosis, as well as analysis of existing production capacities usage.

In order to calculate the return threshold, you must know that the cost of the product and the return rate size are in close dependence with the ratio between the amount of products made and the total production expenses.

In relation with the production volume dinamic, the production expenses elements are grouped as:

- **set expenses**: expenses which remain the same regardless of reasonable production change (+/-50%) (Usually expenses which cover personnel salary, phones, mail, publicity, etc.) E.g. for a SMEs in the field of metal processing, set expenses represent approximately 30.000 Euro/year and cover the salary of the secretary, the accountant, the CEO, the guards, electric energy for offices and warehouses, phone, fax and mail;
- **variable expenses:** expenses related to modified production volume (usually, expenses that cover prime materials, utilities, working personnel salaries etc.)

Figure 1 presents the principle of the return threshold method.

According to the plot of the critical point (see figura 1), define the following four straight line:

The straight line 0-V, representing proceeds or income, $y = ax$ (1)

The straight line C-F, representing the fixed costs, $y = c$ (2)

The straight line C-VI, representing variable initial expenses, $y = bx$ (3)

The straight line C-VF, representing the final variable expenses, $y = bx + c$ (4)

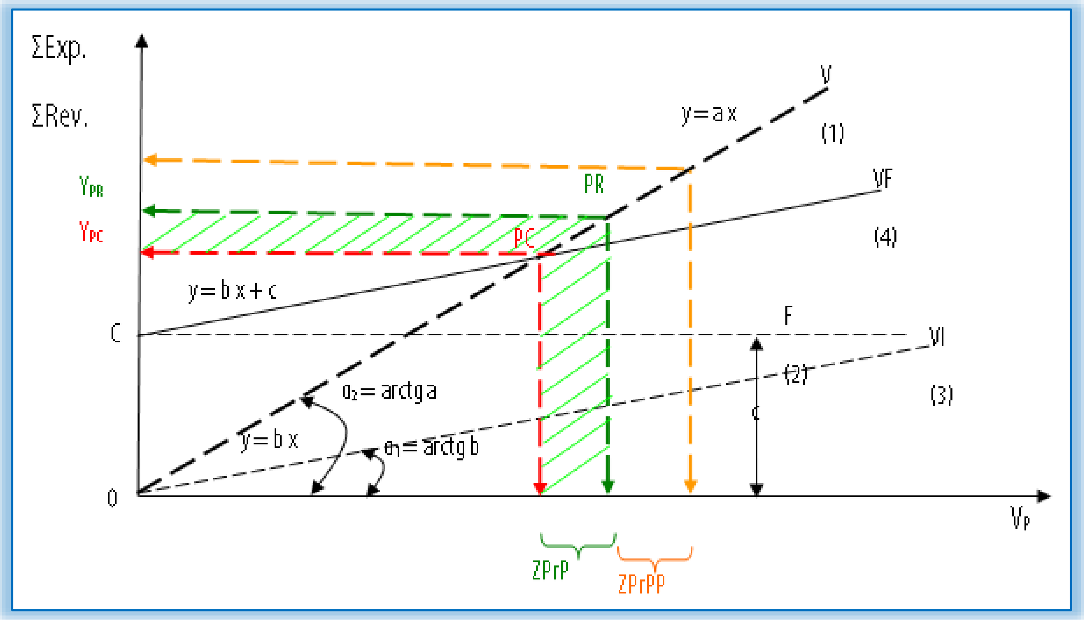

Figure 1. The principle of the return threshold method

As a consequence, variable expenses are constant in relation to product unit (they rise/fall proportional to production volume), and set expenses are variable in relation to product unit (their value is constant, which means they rise/fall with growth/decrees of production volume).

This link between production expenses value and the quantity of products that must be made, so that obtained incomes cover all expenses, is highlighted using the return threshold, which is determined differently, in physical or valor units, for a single product or the whole activity.

4. CONCLUSIONS

The presented paper has established the economic and managerial aspect of the development properties of the aluminum alloy, the following being highlighted:

= Aluminum is found in nature as compounds, having a high affinity for the oxygen in the air, being easily covered with a layer of oxide which protects the metal from further oxidation.

= First time manufacture of aluminum tin foil and usage of aluminum in newly developed aviation and automobile industries, by the firm Alco from USA.

= Technological and managerial procedures of aluminum alloy development have a high energetic efficiency, for a more advanced deoxidation and refinement and also a shorter development duration.

= Using a more profitable economical method to develop aluminum alloys, a method for analyzing product rentability and overall activity rentability, the rentability threshold method.

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