CONCERNS REGARDING CORRODED METALS MICROSTRUCTURE FOUND IN CONTACT WITH FOOD DURING FREEZE DRYING PROCESS

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REZUMAT.Uscarea prin congelare este un proces de uscare caracterizat prin eficienţa, ingeniozitatea şi noutatea sa. Procesul constă din congelarea produsului, după care, prin sublimare se extrage umiditatea din acesta. În cadrul cercetării s-a folosit experimentul liofilizării unor probe de lapte şi carne aflate în contact cu tabla de aluminiu, tabla de alama si tabla de oţel inoxidabil. După o analiză a microstructurii metalelor, lucrarea cuprinde si unele concluzii privind comportamentul reciproc al cuplului metalul-aliment..

Cuvinte cheie: uscarea prin congelare, microstructura, alimente, metale, coroziune**.**

ABSTRACT.Drying by freezing, is a drying process characterized by efficiency, ingenuity and novelty. The process consists of the product freezing, followed by sublimation moisture is extracted from it. In the research experiment was used freeze drying samples of milk and meat in contact with aluminum sheet, plate of brass and stainless steel sheet. After an analysis of the microstructure of metals, the paper contains some conclusions about the behavior of each metal-food.

Keywords: freeze drying, microstructure, food, metals, corrosion**.**

1. INTRODUCTION

Accompanying processes during lyophilization, the food coming into contact with components of the technical system, especially with the food tray where is placed. Undoubtedly the quality of the tray play a major role, with significant effects on food quality powder. The progress in construction of industrial equipment for food freeze drying (such as mechanical loading version with the possibility of constructive or automated), have meant also the conception, design and manufacture of the trays by different shapes, sizes and materials.

The choice of appropriate materials for to use as efficient and as for a long a time is primarily depending on the chosen material properties, which must be chosen according to the nature of food material, considered a potential aggressor from materials coming into contact with food. It must be taken into account all of the materials, chemical composition, structural state, technological properties and, in general all use properties.

The materials used in construction of the trays must to meet standards of food equipment must withstand stresses that occur in normal operation and maintenance of equipment for freeze drying, requests may be appropriate: mechanical friction, corrosion, erosion, thermal, ingress / adhesion of parasites, bacteria, enzymes, impurities developed / in the food environment. Parts are considered those that come in direct contact with food material subject during lyophilization. They must be harmless to the food material and resistant to requests that occur during the processes that occur during lyophilization.

In general, the criteria which must to be considered when choosing materials for building components metal food equipment are:

- Stability of operating conditions;
- Compatibility with the environment comes in contact with the material (temperature, aggression, and hygiene conditions imposed by the process);
- Compliance with standard EN 1672-2 (identical to European Standard EN 1672-2:1997), entitled "Food processing machinery. Fundamentals. Part 2: Hygiene requirements. "Materials whose surface in contact with food material must meet the following requirements:
  - Be resistant to working temperature;
  - Be non-toxic;
  - Be resistant to corrosion in contact with process materials, cleaning agents and cleaning and normal factors of working environment;

- Smooth surfaces, easy to clean, clean and corrosion resistant or protected against corrosion;
- Accepted materials for food to be approved in terms of hygiene and health.

Therefore, high temperature alloys used must meet the following requirements:

- As high mechanical characteristics (creep good behavior);
- Stability (resistance) to oxidation or other chemical action;
- Thermal and mechanical shock resistance (blows);
- Thermal conductivity;
- Expansion and modulus of acceptable values;
- Price as low cost.

2. MATERIALS AND METHODS

Conducted experimental research aimed at studying the behavior of five types of metallic materials in contact with during lyophilization several categories of foods:

- Aluminum plate 1050, according to EN 485/573, H24;
- Brass sheet, thickness: 0.4 mm, an alloy Cu-Zn, according to STAS 199/2-86, CuZn37;
- Austenitic stainless steel plate chrome-nickel, with the addition of titanium, 1.4541 / X 6 CrNiTi 18-10 / DIN EN 10088 / DIN 17 440, AISI 321 / BS 321 S 31 / SIS 2337.

Microscopic analysis was performed in two situations:

- Optical microscopy (OM) samples of metal with a light microscope OLYMPUS SYX7 in materials science laboratories of the Faculty of Mechanical Engineering.

Figure 1. – *Optical microscope Olympus SZX7*

The behavior of metallic materials in contact with food during freeze drying process is performed taking into account the actual conditions of industrial units and the particular laboratory facilities which made food lyophilization.

Figure 2. – *Scanning electronic microscope Inspect S.* (National Institute for Elecrochemical and Condensed Materials of Timişoara)

3. RESULTS AND DISSCUSION

To achieve the objectives of this work, experimental research has focused on the study of metallic materials for construction trays used as support material during lyophilization food.

Following research carried out on metallic materials that have been in contact with food during several freeze drying processes resulting microstructure in Figure 3.

4. CONCLUSIONS

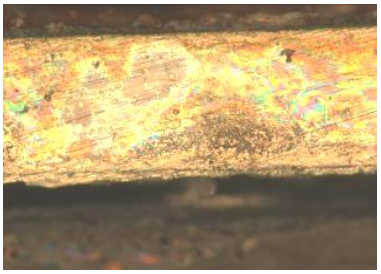
Because the most common negative effect on the metallic material in contact with food is corrosion freeze drying subject was necessary to analyze all possibilities of corrosion (reflected in current literature), which may have resulted during lyophilization. Study on corrosion of metallic materials has been achieved from theoretical considerations, based on which the assessment is considered evidence of corrosion. To study the influence of corrosion on structural and operational solutions trays have been taken into account the factors that influence resistance to corrosion.

Microscopic analysis of metal samples, investigated with the most advanced equipment, using both optical microscopy and electron microscopy using. Can note the presence of corrosion by multiple forms, adding some unexpected issues. Were determined certain shapes,

quite low, inter-crystalline erosion, especially in softer materials (blackboard, brass, galvanized sheet). These metallic materials also were observed point forms of corrosion. The stainless steel samples, were observed mainly localized forms of corrosion (type "pitting"). If reuse trays, these forms of corrosion can be primed and / or propagated, thus emphasizing the surface degradation.

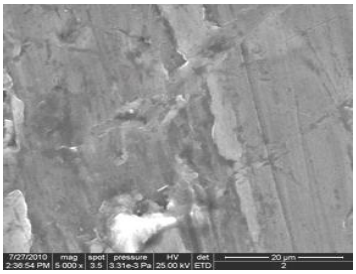
Notification appearance of novelty is the presence of two types of film, protective film, comprising basic metal oxides and biological films, characteristic of each type of food. Biological film is observed in areas including surface imperfection, previous craters, scratches, traces of the previous processing.

The situation of the state of corrosion more pronounced (in some materials: black metal, brass, galvanized, aluminum), or less visible (the stainless steel plate), constitutes a threat for reuse trays, especially when the cleaning can not be achieved with sufficient accuracy. From this results the observation it must to have established the maximum acceptable number of reuses, the occurrence of contamination within the food. The danger resulting from these investigations using from the aluminum plates, quite vulnerable to attack food compositions, intimate level of the material, the risk effects of food quality powder vicious.



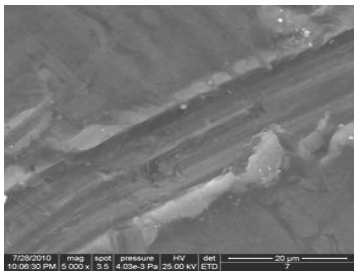
a) MO 200x

3a) *in contact with milk*



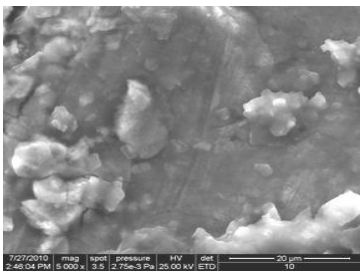
b) ME 5000x

3b) *blank sample*



c) ME 5000x

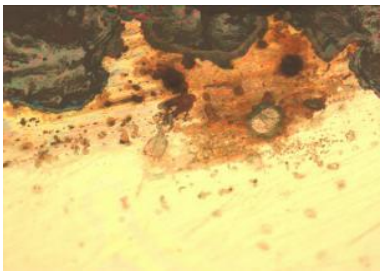
3c*) in contact with beaf meat*



d) ME 5000x

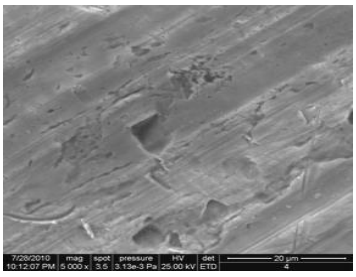
3d) *in contact with milk*

Figure 3. *–Microscopic representation of the aluminum plate in contact with milk and beef during lyophilization*



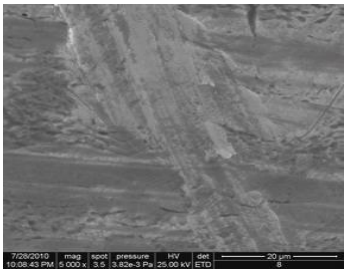
a) MO 200x

4a) *in contact with milk*



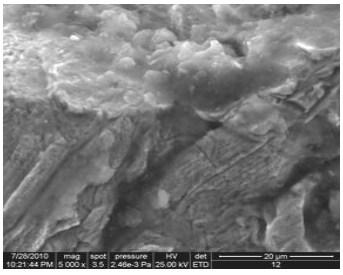
b) ME 5000x

4b) *blank sample*



c) ME 5000x

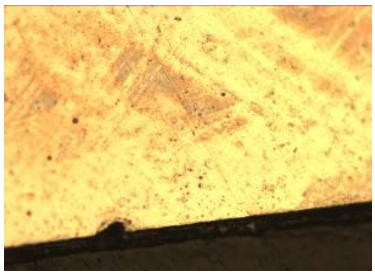
4c) *in contact with beaf meat*



d) ME 5000x

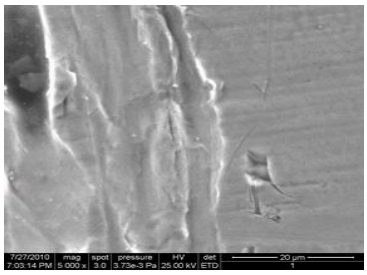
4d) *in contact with milk*

Figure 4. *– Microscopic representation of the brass plate in contact with milk and beef during lyophilization*



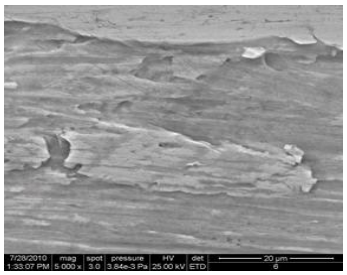
a) MO 200x

5a) *in contact with milk*



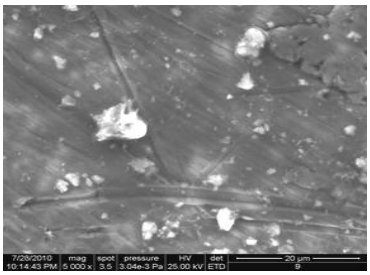
b) ME 5000x

5b) *blank sample*



c) ME 5000x

5c) *in contact with beaf meat*



d) ME 5000x

5d) *in contact with milk*

Figure 5. - *Microscopic representation of galvanized sheet in contact with milk and beef during lyophilization*

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