ASPECTS REGARDING THE BIOCORROSION OF THE PAPER MANUFACTURED MACHINES

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ABSTRACT

This paper presents the main microorganisms causing biocorrosion, the concentration, their effects and a series of measures for their reduction.

The conclusion is that the sulpho-reducing bacterius are responsible for the majority of defects that take place in the paper industry.

KEYWORDS: widia plates**,** thin layer, cutting

1.Introduction

The metals corrosion consists in the spontaneous, partial or total distruction of the metals as a results of some chemical, biochemical or electro-chemical reactions happened during their interaction with the environment.

It is estimated that 20% of the serevising expenses in the cellulose and paper industry are due to the corrosion problems. The concept of microbiological corrosion (chemical corrosion, biochemical) can be controversial, because there are few cases when physical and chemical phenomena do not take place. Bioccorosion is determined by the activity of the different microorganisms that use the metal as a medium of culture (vital metabolic element) representing a resultant of a asssembly of metabolic reactions catalysed by enzymes.

The types of microorganisms that affects the unit from the cellulose and paper industry are inferior form members of vegetable life, mainly the bacteriums, algas and the fungies.

2. The causes of the microbiological corrosion

The micreobiological corrosion can be caused by three phenomena:

-a "chemical" attack because of the metabolic products with agresive activity over metalssuch as sulphuretted hydrogen, sulphuric acid or organic acid;

-a "physical" attack under the form of deposits that isolate locally the metal, prevent the inhibits of corrosion, or simply create the conditions for a corrosion differential aeration;

-an "enzime" attack directly responsible for the enzime equilibrum dispalcement, by means of a depolarfization action of a micoorganism at the anode (the case of bacteriums of iron).

In reality the microbiological attack of the metals is translated by an assembly of electrochemical reactions and it is a special case of corrosion in watery medium, at a temperature compatible with the micoorganisms activity, in the presence of the molecular oxygen or under anaerobic conditions and in a large scale of pH from 1 to 10. among the microorganisms, the sulpho-oxidizing, the sulpho-reducing and ferruginous have the greatest contribution to the corrosion.

3. Experimental data

The paper industry is a "wet" industry that vehiculates by quantities of water (10-50 m^3/t paper). Water is the main source of microbiologic infection of the paper mill system and of the paper products. A bacterium/ 1 ml of water correspends already to 10^6 bacteriums/m^2 and taking into account the specific consumption of water per tone of paper, there are billions of bacteriums that contaminate daily the paper machine.

A temperature close to the incubation temperature, nutrients in big quantities leads to a exponential rise of the bacteriums.

Taking into account this fact, it was required the identification of the main microorganisms responsible for biocorrosion and the affected installations. Among the sulpho-reducing bacteriums, the most frequent species in the papers mills is the bacterium Desulphovibrio desulfuricans. The sulpho-reducing bacteriums are anaerobic bacteriums, that grow better at a pH = 5.5 – 8.5, in the presence of organic substances and of a moderate concentration of sulphate.

Desulphovibrio desulfuricans, being a bacterium gram negative uses hydrogen from organic

substances, reduces sulphates, sulphites, tiosulfite at H_2S, being able to produce up to 3100 mg H_2S/l.
Some anaerobic bacteriums such as Clostridium spp. and Desulphovibrio spp., create secondary corrosive produces that can completely make holes in the stainless steel of ¼ inch in several months or even weekes.

Figure 1 presents the aspect of the Clostridium and Desulphovibrio bacterium.

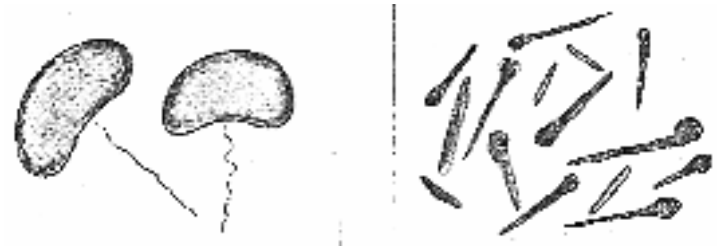

Fig.1. *The aspect of Clostridium and Desulphovibrio bacteriums.*

These bacteriums caused the corrosion of the headbox, of the Gautsch roles make of stainless steel, of the pipes and pumps.

Figure 2 presents the corrosion of some metallic stainless surfaces caused by the sulpo-reducing bacteriums.

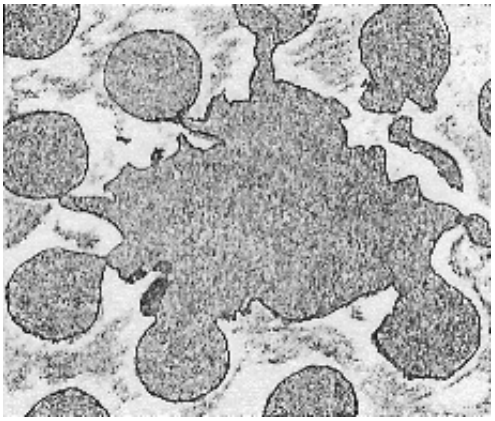

Fig.2. *The corrosion of some stainless steel metallic surfaces provoqued by sulpho reducing bacteriums.*

The ferro-bacterium or the ferric bacteriums are aerobic bacteriums that takes the energynecessary to the metabolism from the oxidizing the ferrous salts in feric salts.

This transformation is favoured by an enzyme suitable to those bacteriums.
The reactions that takes place are the following:

$$FeCO_3 + 3/2\ H_2O + 1/2O2 = Fe(OH)_3 + CO_2 + 92{,}5\ cal.$$

$$2FeO + O + 3H_2O = Fe(OH)_3 + 353\ cal.$$

$Fe(OH)_3$ is deposited under filament form at the Leptothrix (fig.2.), Cronothix, and at the Gallionela under the forum of bands.

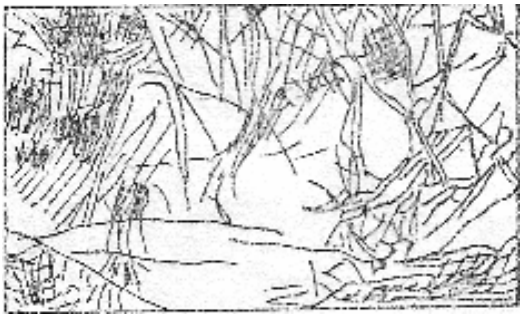

Fig.3. *Ferruginous bacteriums of Leptothix type isolated from the water supplying pipes.*

These bacterium tend to a row fast and to form deposits that adhere to the inside of the pipes, tanks, nozzles preventing the following and contributing to the corrosion process is represented by the anaerobic conditions created and that ensures a favourable medium for the growth of the sulpho-reducing bacteriums.

The algae are nexious to metals on the one hand through metabolism produces that modify pH and the water purity and on the other hand through their provinently growth cause deposits of substances with a gelatinous aspect or under the form of crusts that represent substratums for the growth of other microorganisms. The acummulations of algae can ostruct the filters, sieves, nozzles, and pipes can cause indirectly corrosion located in the growing areas. The most frequent algae are the green and blue-green ones.

Figure 4 presents the blue-green filamentous alga, called Lyngbya ussually found in reservoirs and clarifiers.

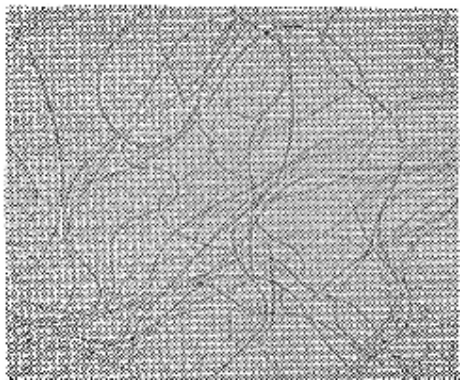

Fig. 4. *Blue-green fillamentous algae.*

Fylamentous blue-green algae Lyngbya usually found in reservoirs and clarifiers.

Among the fungus, some species of moulds are implied in corrosion phenomena, they act on the substractum mainly through a series of metabolism produes. Thed moulds identified on the circuits of the paper machine are show in figure 5.

The weight of the microorganisms found on the fabrication circuits causing corrosion is represented by bacteriums. Table 1 presents the content of microorganisms in the paper fabrication.

The content of microorganisms in the paper fabrication. (nr. of microorganisms/ 1 g dry substance or 1 ml. licquid).

Table 1. *The content of microorganisms in the paper fabrication (nr. of microorganisms/ 1 g dry substance or 1 ml. liquid).*

Sample	Bacterims [millions]	Fungus [thousand]
Industrial water	0,14	0,02
Paper paste	49,56	65
Greasy water	17,60	100

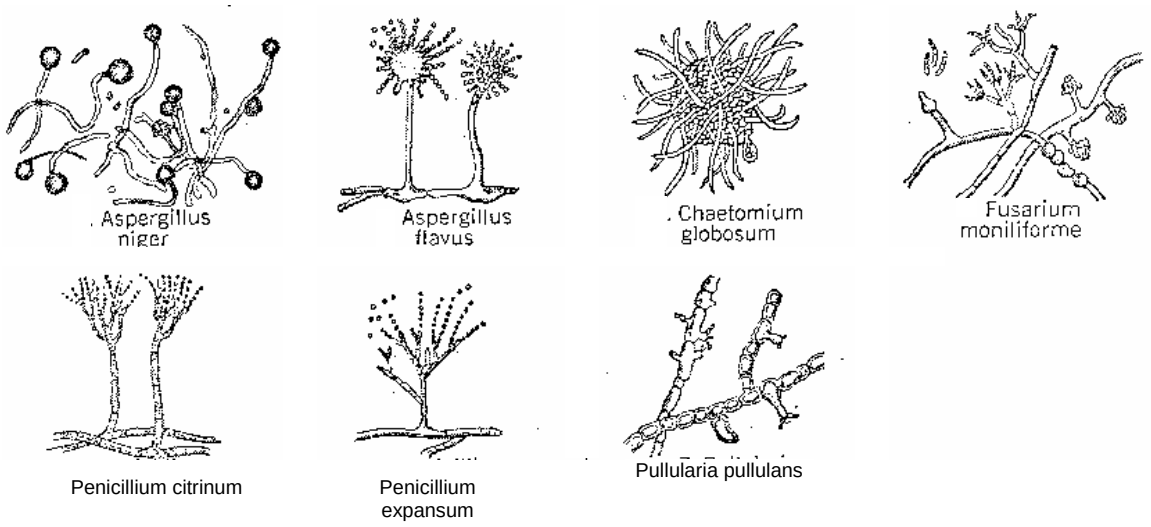

Fig. 5. *Moulds identified on the paper machine.*

In order to combat the microorganisms causing corrosion, a great variety of chemical ageents can be used, agents knows as biacids, which act on the enzyme systems of the microbical cells or a bioprocessual technology.

This bioproseccual technology experimented by us consists in the introduction of some culture of selected bacteria (BIOLEN IS 80) on residual waters circuits, which have the capacity of degrading the organo-sulphirized products (without H_2S evolution and sulphide formation) have influences over the corrosion and smells reduction.

Tabelul 2 presents the reduction of S^{2-} and SO_2^{2-} content in the residual water at BIOLEN IS 80 using.

Table 2. *The reducing of S^{2-} and SO_4^{2-} content at the BIOLEN IS 80 using*

Components	**Initial**	**Samples with BIOLEN**		
		After 24 h	After 48 h	After 72 h
S^{2-}, mg/l	5,3	4,5	4,3	4,2
SO_4^{2-}, mg/l	56	5,3	50	50

The sulphide content decreased with 18,9%, after 48 hours and with 20,8% after 72 hours, but the sulphide content decreased with 5,35% after 48 hours.

4. Conclusions

Bioccorosion is a complex problem that require the detailed analysis of the deposits existant on the fabrication circuits. The greasy water characteristics may have an important role in the corrosion and deposit problems. The construction materials of the system may also help the generated problems. The possibility of the corrosion appearance will be significantly increased by the deposits presence. The sulphide-reduction of sulphur bacteria are responsible for a great amount of defects that take place in the paper industry.

References

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