An Ecological Method for Slime and Deposit Control

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ABSTRACT

Strong microbial growth in technical water systems may cause, not only in the paper making process, a multitude of undesired effects. Problems occur particularly when microorganisms agglomerate and adhere to the walls of the system (formation of a biofilm). Increasing deposits of sticky materials are the cause of problems in waste paper treatment.

For a trouble-free operation an optimum slime and deposit control is very improtant. The objectives are a long operation time, longer intervalls for the system cleansing and high product quality by applying harmless and economical products.

A new series of ecologically compatible anti-deposit and anti-slime additives is presented which are being used successfully to avoid deposits and stickies as well as a reduction of biological slime in machine systems.

Two detailed case histories explain the use and further possibilities for other applications are presented.

INTRODUCTION

In paper and board production all in-plant circulation systems are being restricted to an increasing extent, in order to protect natural resources, and at the same time more and more waste paper is used. This results in a higher and higher concentration of colloidal and soluble substances in the production water in paper mills. Furthermore, poor waste paper qualities and coating scrap with starch cause additional contamination of the water circulation systems.

These water systems, which are highly contaminated with organic materials, provide a very favourable environment for microorganisms if the temperature is suitable. Strong microbial growth is unavoidable, and is further encouraged by neutral operation and a chlorine-free bleaching process. This results in slimy deposits on the insides of the water circulation system, and the formation of a biofilm.

Formation of biological slime results from the activity of the microorganisms, which are characterised

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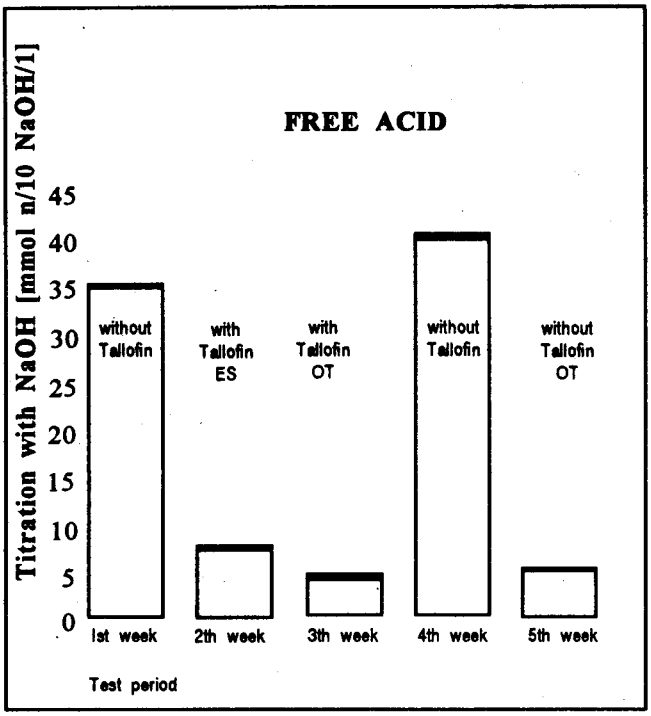


Graphic Free Acid

Figute-I Determination of free acid as a measure of small development during an industrial trial in a paper mill for packing papers.

by their high rate of multiplication, and which can make use of many different types of organic and inorganic substances. In this respect the bacterial production of extracellular polymer substances (EPS) is of particular importance bringing about coherence of the bacteria and being responsible for stabilisation of the films on the surface. Apart from water, which is bound mainly by EPS, many different types of microganisms, wood fibres and fillers are also integrated in the biofilm.

CONSEQUENCES OF MICROBIAL SLIME FORMATION

One of the most serious consequences of slime deposits can be microbially influenced corrosion in pipes and machine parts. This results from a concentration of anaerobic microganisms, forming hydrogen sulphide and organic acids. The metabolic products, which are to some extent strongly acid, reduce the pH-value and promote corrosion. Even stainless steels, mineral materials and plastics are affected in some cases.

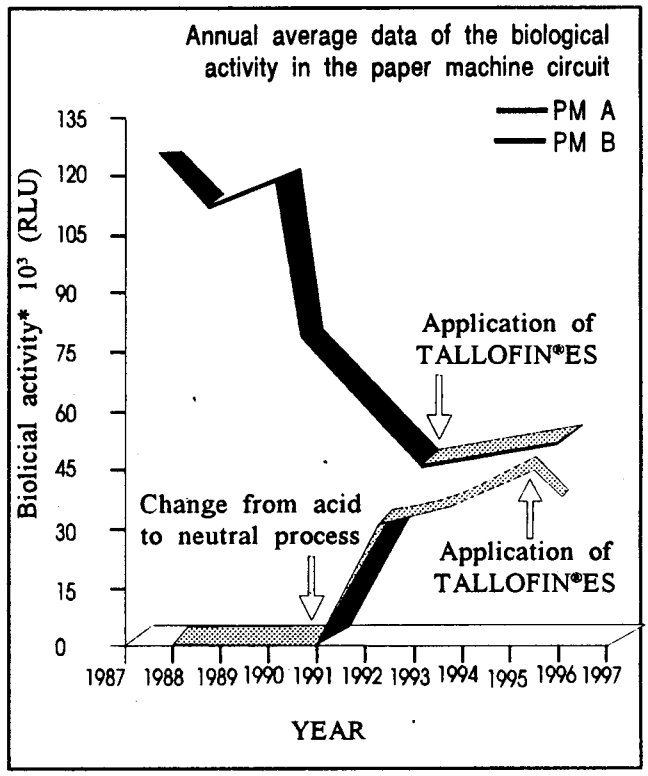
Detachment of parts of the biofilm and removal of these lumps by the flowing water can cause severe disturbances in the production process. Apart from holes and impurities in the paper, the paper strip may be torn, thus causing a direct breakdown in production.

Blockages in valves, pipes and fittings caused through detached slime lumps or corrosion products may lead to an erratic running of the paper machine.

The formation of strongly smelling metabolic products, such as organic acids, causes an obnoxious smell in the paper machine circulation system and in the finished paper. The smell nuisance may even lead to complaints from local residents.

HISTORICAL METHODS FOR CONTROL OF SLIME AND DEPOSITS

In order to inhibit microbial growth, or to destroy the microorganisms, highly effective, but also ecologically harmful bacterial poisons, such as organic



Graphic Biological Activity

Figute-2 In the testing period from 1993 to 1995, it was confirmed that by using Tallofin on PM A, Microbiological activity can be maintained at the same level on PM B with the parallel use of quaternary ammonium compounds. As a result conversion to Tallofin ES was also carried out on PM B.

chlorine/bromine compounds, isothiazolone, glutaraldehyde, methylene bisthiocyanate and quaternary ammonium compounds, are generally used. These compounds act by inhibiting growth of the bacteria to such an extent that the system operates perfectly, free of disturbances.

The disadvantages of this method of slime control are well known. The biocides are to some extent harmful to human beings, and result in considerable pollution of the environment (water pollution class 2 and 3). Apart from the quaternary compounds, almost all biocides are ineffective in the neutral range. Furthermore, microorganisms tend to adapt themselves to biocides, which frequently necessitates to chanage the biocide active substance and/or to increase the dosed quantities. If the microbiocides enter a biological waste water purification plant connected downstream, they can also endanger the microbiology of this plant.

It should be noted that in the production of paper and board for contact with food, the slime control agents used are listed in the positive list of Recommendation XXXVI of the Plastics Commission of the (German) Federal Institute for Consumer Health Protection and Veterinary Medicine (BgVV) (formerly German Federal Board of Health).

For an optimisation of biocide application with respect to the most effective, low cost slime control possible, considering the requirements for health and safety, environmental protection and currently applicable legislation, comprehensive, costly concepts are necessary. In addition to the responsible use of biocides, alternative methods of slime control are becoming more and more popular.

A NEW CONCEPT FOR SLIME AND DEPOSIT CONTROL

Bearing this in mind, ecologically compatible products have been developed, with which microbial growth can be effectively inhibited and deposit formation prevented. These newly developed products, under the trade name TALLOFIN®, are an aqueous formulation of hydrocarbons, or more exactly, a modular system consisting of a complex emulsifier combination (x) and a non-aqueous phase (y), of the form

$$f \{ x + y \} = \text{TALLOFIN®}$$

The individual modules can be adapted to the prevailing conditions, depending on the requirements of the systems.

The desired effects are brought about by the combination of active substances.

The dispersing effect is produced by penetration of the emulsifier component into the cell walls of the individual bacteria, thus loosening the compact structure. The binding forces in the slime and, consequently, the viscosity of the bacterial slime, are considerably weakened. These unstable biofilms can be more easily swept away by the flow, and any detached slime lumps disintegrate through the turbulence in the circulating water.

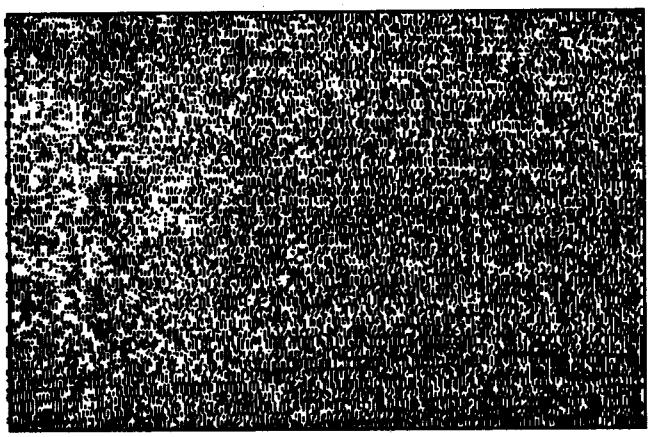
Through the enveloping effect the growth rate of the bacteria is considerably reduced. The bacteria are enveloped by the stable product emulsion in the water, so that their metabolism is inhibited or stopped. Explosive bacterial growth is thus prevented. The stickies are also coated, so that formation of sticky agglomerates is significantly reduced.

The creep effect is brought about by the paraffin component in the product. Through its affinity to hydrophobic surfaces it has the property of infiltrating already existing deposits, and to detach these from the surface.

This results in circulation systems and material surfaces which are practically free of deposits with very easy application of the products. A particular advantage is that TALLOFIN® is harmless to human beings and to the environment. The products are classified in water pollution class 1, and are biologically degradable. Furthermore there is no adaptation effect, as known from the use of biocides, in the application of these products.

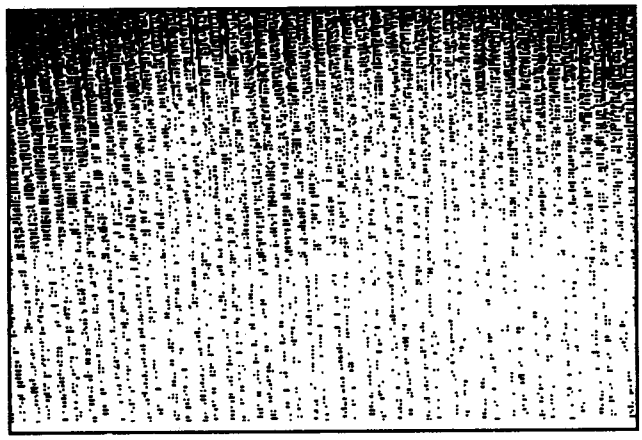
In all applications up to now, no negative effect on sizing, retention and dewatering has been observed. The products show no tendency to foam formation and do not cause ingress of air into the material. There is also no danger to the microbiology of biological waste water purification plants.

In accordance with Recommendation XXXIV of the Plastics Commission of the (German) Federal Institute for Consumer Health Protection and Venterinary Medicine (BgW) and the Food and Drug Administration (FDA) the use of TALLOFIN® in the production of food packing papers is safe.



COMPARSON - PIPES

Contaminated felt impairs product quality



COMPARSON - DRY FELTS

Tallofin keeps the drying screens cleaner

PRACTICAL EXPERIENCE

The products described above have already been successfully used in many different industrial applications, the main fields of application being in the paper indusrty and in the treatment of fresh water, cooling water and industrial (process) water. Apart from slime and deposit control in water and paper machine circulation systems, the product is also used as a system cleaning agent. It is also applied for controlling sticky impurities (Stickies), and reducing strongly smelling metabolic products.

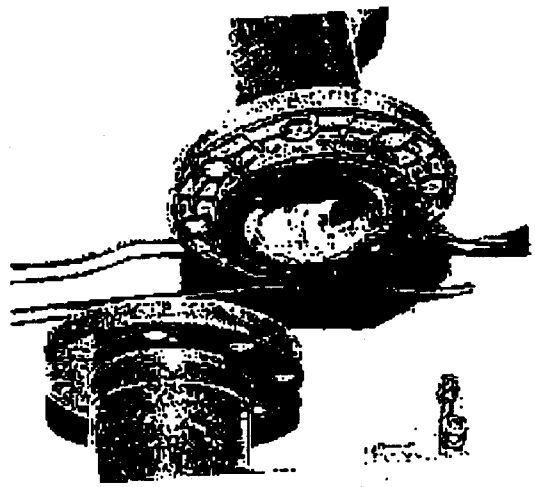
The Haindl works in Duisburg-Walsum was the first paper mill to recognise the advantages of these new products, and played a major part in introducing this product series into industrial practice. Since the beginning of 1994, TALLOFIN® ES has been successfully applied for slime control, instead of the previously used quaternary ammonium compound. This paper mill produces approx. 450,000 tons LWC per annum from pulp and TMP, on three papermaking machines. The specific fresh water requirement amounts to 12 ltrs/kg paper.

Through conversion of the PM B machine in 1991 from an acid to neutral mode of operation in the mill, the system for slime control also had to be fundamentally modified. The biocides previously used became ineffective with the changed pH conditions, and were replaced by quaternary ammonium compounds. These compounds belong to the few substance classes which give satisfactory results in the neutral mode of operation. However, strict regulations with regard to labour and environmental protection must be observed when handling these products.

Extensive laboratory tests were carried out to find alternative products, and TALLOFIN® ES was found to be the most effective alternative. In subsequent industrial scale trials the results obtained in the laboratory were confirmed.

For slime control in the circulation system of papermaking machine, this product is added in dosed quantities to the white water circuit. The microbiological activity is controlled on the spot in the circuit water, by means of the luminous bacteria test, based on the ATP concentration (ATP = adenosine triposphate - the most important energy storer and transmitter of the cell). In comparative tests on paper machines A and B, of similar construction, it was found that microbiological activity was at the same level as when quaternary ammonium compound is used.

ENVIRONMENTAL ISSUES



Pipe after using Tallofin

Conclusion: Microorganisms can also be effectively controlled in the neutral range with TALLOFIN®. No biofilm is formed, and no sheet breaks occur through the accumulation of slime.

Apart from slime control, a special product from this series has proved itself in dry felt cleaning. A representative example for this application from the paper mill at Vreden is described below.

This factory produces approx. 55,000 tons/annum of corrugated material and screenings on two paper machines. The operation runs with a 100% closed recirculated system. Waste paper is used as raw material.

The high proportion of strange material in the waste paper causes accumulations of sticky substances, often called bitumen, which are deposited on the wet dry felts. These, frequently, consist of mixtures of book-back adhesives, hot melts from illustrated magazines and adhesives from adhesive tape in department store waste.

These deposits soften on the hot drying cylinders, and are pressed into the meshes of the dry felt, thus being transported through the complete drying cylinder, section. The paper web then transfers the sticky lumps onto the surface of the drying where they have to be collected and removed by the doctor blades. Frequently, these sticky lumps lift up the doctors, resulting in breaks and holes in the paper sheet. The above mentioned contaminants have a negative effect on the drying rate. A non-uniform drying profile of the paper sheet can also be caused by this contamination of the dry felt.

In the past, expensive cleaning of the dry felt by hand was necessary during the weekly standstill period for cleaning and maintenance of the plant. However, it was not always possible to get the dry felts satisfactorily free of bitumen or latex particles using a doctor and high pressure cleaning machine.

In order to overcome the disadvantageous effects of these sticky substances, TALLOFIN® DB has been successfully used since the beginning of this year for felt cleaning. Cleaning is carried out by spraying the product as a 15% solution onto the dry felts of the first upper and lower group, using a shower. The frequency of dosage has been adjusted to one application per shift, with a consumption for approx. 30 ltrs of diluted solution.

Through this treatment the felts and cylinders of the drying section are kept noticeably cleaner, mechanical hand cleaning of the dry felt is much easier and is only necessary in exceptional cases. The main advantage, however, is that the quality of the finished paper is improved through an improvement in the moisture profile.

In this way quality variations during subsequent product in of corrugated board, specially in the production of E-corrugated board, are minimized.

Contaminated felts impair the product quality (C.P. 88)

TALLOFIN® keeps the drying screens cleaner. (C.P. 87/1)

These examples represent two of many practical application possiblilities for this product series, which prove that effective slime and deposit control is also possible without using toxic products. The TALLOFIN® concept is currently being used on approx. 70 paper machines worldwide.

OTHER APPLICATIONS

These products have also been successfully used in system cleaning (rinsing of the circulation system). Deposits are removed in the complete wet area of the paper machine, particularly at the head box and in spraying pipes. Thus, damage to the wire is prevented and the cleaning intervals increased.

In the drying section there is less contamination of the dryer surfaces, and less dirt is produced from the doctor. Specific application to the drying screens can also reduce their contamination. By means of special cleaning machines even highly contaminated screens can be cleaned. Apart from their application for slime control and prevention of deposits in paper machines and water circulation systems, the products are also used in the fresh water treatment process.

Effects are achieved in water treatment similar to those in paper production. In addition, Considerable success has been achieved in cooling and industrial (process) water in case of the treatment of heat exchanger surfaces. The products prevent the formation of deposits on these surfaces, and this results in higher efficiency of the complete plant. In one case of a cooling tower operator, it was possible to reduce the quantity of chlorine previously used to a third,

thus reducing the AOX pollution.

Apart from improved cleanliness of the screens of screen filter presses and less slime formation in spraying pipes, a reduction or suppression of strong smelling bacteria in waste water treatment has also been observed.

In wood pulp production, problems are caused where deposits are formed from resin (which is separated from the wood during the boiling process), in combination with water hardness. The use of TALLOFIN® has also proved to be very successful in preventing formation of these deposits in the evaporating station.

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