ADVANCED WASTE WATER SOLUTIONS
INNOVATIONS IN SUSTAINABLE WATERTECHNOLOGY

Lazur: the effect of ultrasonic waves on biofilm

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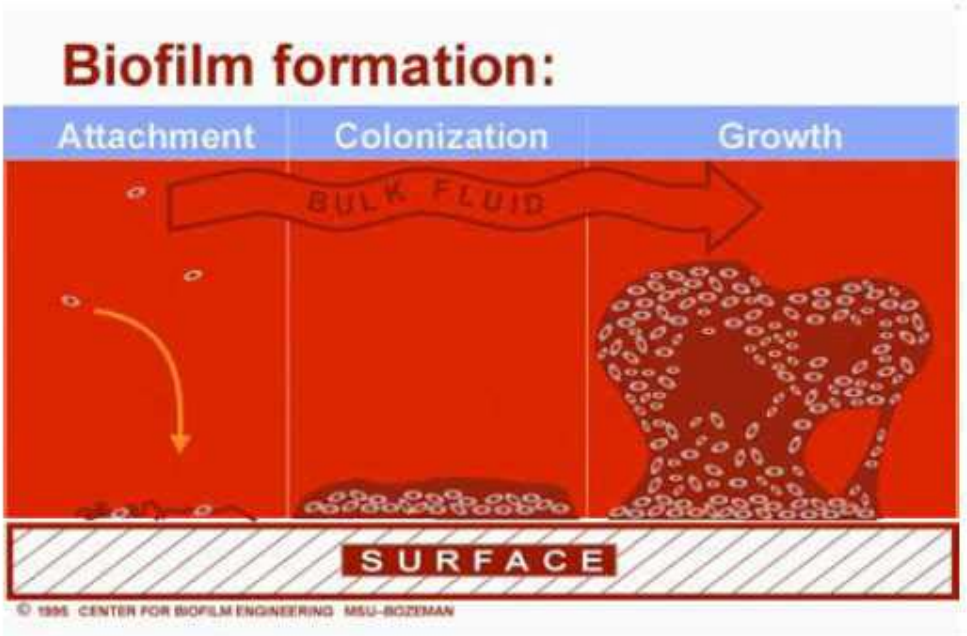
1 Introduction

Biofilm growth also known as bio fouling will take place everywhere in a system where there is biodegadable COD and oxygen. The biofilm is built up from organic and inorganic substances:

- Organic substances:
  - Bacteria, biofilm associated colonies. Especially the Aeromonas species has biofilm forming abilities
  - Higher organisms (amoeba, ciliates,etc.)
  - Extracellular organic polysaccharides, formed by bacteria to start biofilm growth and adhesion
- Inorganic substances:
  - Carbonates and oxides from calcium and magnesium, free calcium ions are also associated with biofilm growth
  - Metals e.g. iron, are found in biofilms.

Biofilm growth rate depends on the amount of oxygen and COD that is available.



The rinsing water from apples and pears washing contains a lot of easily biodegradable compounds. These are mostly sugars. Apples and pears do not contain a lot of nitrogen en phosphorous in there biomass. When the COD is to be biodegraded, the microbial biofilm will have a limitation in nutrients.

As a consequence, the biofilm growth will be limited in speed and nutrients are recovered from one bacteria to another. The reflex of bacteria which are growing nutrient deficient is the production of EPS: the extracellular substance which is needed for biofilm adhesion. This sticky substance leads to very slimy biofilm formation.

Because of these slimy substances, this waste water is an ultimate test for the removal of biofilm from the quartz sleeve surface, due to the application of ultrasonic waves in the reactor. In the next chapter, the results are presented.

2 Results and discussion

In the phase of the test, the UV is turned on without the use of the ultrasonic device. The water is loaded with COD (easily biodegradable) and oxygen. The slimy biofilm is formed in the biological reactor but also on the UV quartz sleeve. This first step has taken place during 2 weeks of biofilm growth.

As a result of this, the UV dose to the water reaches near zero: the UV light is not able to penetrate the tightly grown biofilm on the sleeve. The pictures below show the following:

The biofilm is formed on the quartz sleeve but also in the reactor (bound to the metal)

In the second phase of the test, the ultrasonic device is turned on. The ultrasonic waves create cavitation in the water. The imploding gas bubbles attack on the quartz sleeve surface, disrupting the the biofilm and steadily removing it.

- After three hours, the biofilm is removed for about 50% (picture shown below)
- After 24 hours, the biofilm is totally removed from the quartz sleeve and the reactor itself (picture also shown below)

After 3 hours of US: reduction of the biofilm

After 24 hours: totally cleaned quartz sleeve and UV reactor

3 Conclusion

Tests have been conducted on the US system which is integrated on the lazur UV system:

- A waste water is tested with an enormous potential of biofilm formation.
- The ultrasonic system is able to remove the biofilm within 24 hours
- If the ultrasonic system is turned on, no biofilm fouling on the quartz sleeve nor the reactor occurs whatsoever.