life seacan

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Life Seacan for policy markers

Introduction

The overall objective of Life Seacan was to reduce the environmental pressure exerted by fish canning effluents in the marine ecosystem. The project demonstrated the feasibility of two biofilm-based wastewater treatment processes to minimize the environmental impact of the industrial activity on the marine environment: the aerobic granular sludge (AGS) technology and the moving bed biofilm reactor (MBBR).

Due to its versatility, the application of the innovative AGS technology to other industrial sectors was studied. The AGS system could be successfully applied for the treatment of biodegradable effluents from the food and beverage industry. In particular, the dairy industry, wine production industry, poultry meat industry, livestock industry and agricultural sector were identified as attractive application areas for the AGS technology due to the market importance and impact of the polluted effluents.

AGS technology: a compact and sustainable wastewater treatment solution

In the AGS technology, the microorganisms grow in the form of compact aggregates called granules. Anoxic and aerobic conditions are feasible inside and in the outer layer of the granules, allowing the simultaneous removal of organic matter and nitrogen in the same unit. The operation of the system occurs in a sequencing batch reactor (SBR) operated under specific conditions to promote the development of the compact aggregates (granules):

1. Feeding: the reactor is fed in a short time of time with the industrial effluent to be treated
2. Reaction: it takes place by applying air from the bottom of the reactor
3. Biomass decanting: the aeration is stopped, and the granular biomass is decanted inside the reactor
4. Discharge: the treated effluent is discharged, while the biomass is kept inside the system

AGS is a **biological treatment technology** for the simultaneous removal of organic matter and nitrogen from **industrial wastewater** under **aerobic** conditions in **reduced/compact space** requirements.

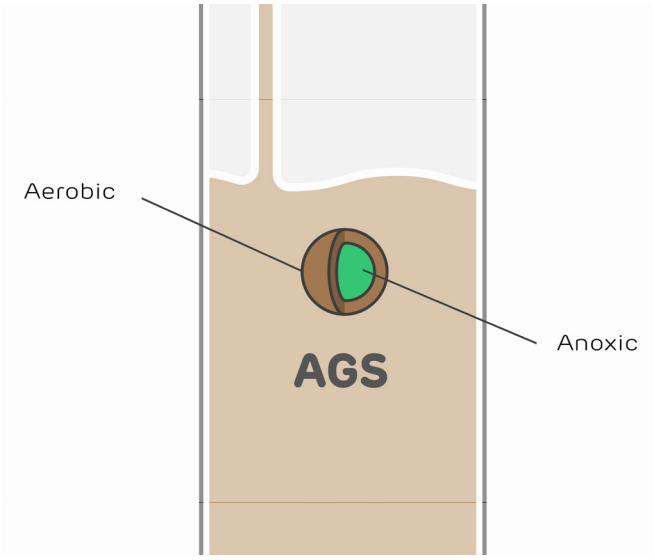
The AGS technology was tested for the treatment of industrial fish canning wastewater in a pilot plant of 3 m^3. The organic loading rate applied ranged from 2 to 7 kg COD/m^3/d. Note that effluents leading to high organic loading rates were composed by high concentrations of organic matter (3140 mg/L) and nitrogen (269 mg NH_4-N/L). The results obtained after the operation of the AGS prototype were very satisfactory with COD removals of 80-90% and N eliminations up to 90% (low organic loading rates) and 40% (high organic loading rates).

Compared to flocculent biomass (conventional biological systems), granular biomass allows the treatment of higher organic loading rates since the biomass concentration in the system is higher (up to 10 g VSS/L). Moreover, the production of sludge is expected to be much lower (up to 30% lower) and the footprint is significantly smaller (up to 80% lower). Also, compared to conventional activated sludge (CAS) systems, the savings in CAPEX are 20-50%.

Besides, AGS technology is robust against strong variations in the effluent composition and to treat wastewaters with high salinity. This was the case for the pilot demonstration within the LIFE SEACAN project (COD = 1000-4000 mg/L; wastewater conductivity = 10-20 mS/cm) and the removal of organic matter was very stable and high during the whole operation. Likely, the granular sludge gives a protection structure which results in a lower impact under varying conditions.

The potential application of AGS technology includes:

- New facilities (greenfield application): companies currently without treatment or integration in companies that do not have biological but do pre-treatments and/or physical-chemical treatments.
- Reconversion of biological treatment plants (brownfield application): for instance, the conversion of SBR or conventional activated sludge (CAS) systems to AGS systems. This will result in smaller plants or plants with higher capacity for the treatment (interesting if the industry needs to grow). Also, the AGS technology would help as suitable biological system to meet the new discharge limits of the new BREF for the food, drink and milk industry.



Food Drink and Milk (FDM) industry

Industrial activity plays an important role in the economic well-being of Europe contributing to sustainable growth but can also have a significant impact on the environment. The industrial activity generates high polluted effluents which need to be treated before their discharge into the water bodies.

The Food, Drink and Milk (FDM) industry is the top employment sector in the EU (14.5 %) and leading employer in the manufacturing sector in more than half of the EU Member States. It produces both finished products destined for consumption and intermediate products destined for further processing. Available statistics show that the EU-28 FDM sector comprises close to 287,000 companies, around 90 % of which have 20 or less employees.

The UN predicts that the world population will reach 9 billion by 2050 and will require 70 % more food production. This will necessarily lead to an increased demand of food, drink and milk products and production.

The FDM sector often depends on the quality and abundance of natural resources, thus preserving the environment (land and water) is crucial for the sustainability of the sector. The level of pollution in water and the amount of waste produced by the industry can represent a significant load in some countries or regions.

Water consumption is one of the key environmental issues for the FDM sector. Water, which is not used as an ingredient, ultimately appears in the wastewater stream. Most of this industrial wastewater is characterized by both high COD and BOD content. The emission levels can be 10–500 times higher than in domestic wastewater. The TSS concentration varies from negligible to more than 100 g/L. Untreated wastewater from some sectors, e.g. meat, fish, dairy and vegetable oil production, contains high concentrations of fats, oils and greases (FOG). Other sectors, e.g. fish canning, have high salinity (salt, brines), which is a challenge for biological removal. In most industries, the production and composition of the wastewater strongly varies, which difficult its treatment.

Water pollution control can be carried out by reducing the volume and pollutant load of the wastewater generated, by an appropriate combination of both process-integrated techniques such as the elimination or decreasing of certain pollutants, the reduction of water consumption or recycling raw materials as well as the end-of-pipe techniques with the clear example of wastewater treatment. AGS technology is an innovative and robust wastewater treatment technology for the reduction of the pollution in complex industrial wastewaters (reduction of organic matter and nitrogen).

European Union legislation regulate pollutant emissions to water from industrial installations operating in EU Member States. Under the IED (Industrial Emissions Directive, 2010/75/EU), new conclusions will be adopted for Best Available Techniques and their application will lead to further reductions in pollutant emissions.

New legislation

In October 2018 was published the final draft of Best Available Techniques (BAT) Reference Document in the Food, Drink and Milk (FDM) Industries. In order to reduce emissions to water, BAT proposes the use of new and efficient wastewater techniques. For this reason, the emission levels to water, apply to direct emissions to a receiving water body, are less than allowed now (**Table 1**).

Table 1 / Comparation between the current discharge limits and the BAT-associated emission levels (BAT-AELs) for emissions to water apply to direct emissions to a receiving water body.

Parameters	Fish cannery discharge limits (1)	NEW BAT-AELs
	mg/l	
COD [2]	350	25 – 100 (3)
TSS	125	4 – 50
TN	57.5	2 – 20 (4)
TP	12.5	0.2 – 2 (5)

(1)_ Current discharge limits of the fish canning plant that hosted the prototypes of LIFE SEACAN project.

(2)_ No BAT-AELs applies for biochemical oxygen demand (BOD). As an indication, level in the effluent from a biological waste water treatment plant will generally be ≤ 20 mg/l.

(3)_ 125 mg/l for dairies and 120 mg/l for fruit and vegetable installations.

(4)_ Not apply when the temperature of waste water is low than 12°C for prolonged periods.

(5)_ 4 mg/l for dairies and 5 mg/l for fruit and vegetables installations.

Main BATs related to AGS technology application:

- According to BAT 11, the implementation of secondary treatment (aerobic and/or anaerobic) is necessary for the elimination of biodegradable organic compounds. Therefore, many industrial factories must adapt their treatment train in order to implement new biological systems to reduce their emission levels (up to 5 times in some cases).

- BAT 7 refers to the water consumption. Since AGS technology can be applied for the treatment of high strength wastewater, the technology helps with the industrial water segregation, needed to reduce the volume of polluted wastewater to be treated. Typically, different polluted streams are generated in the industry (e.g. washing steps (low strength wastewater) or fish cooking (high strength wastewater)). Normally, all streams are mixed in order to reduce the pollution level, since no treatments for high load streams are developed. AGS could promote the split of the streams and to reduce the volume of polluted wastewater.
- For the BAT9, a suitable post-treatment after the AGS treatment (i.e. UF membranes) could promote the water reuse within the industry and therefore, increase the resource efficiency.
- Regarding the BAT10, AGS would prevent uncontrolled emissions to water due to its high removal efficiencies and would promote the implementation of a compact technology, needed when there is a lack of space.

Other aspect highlighted in the new legislation is the bulking problem, very common in conventional activated sludge systems. The application of high organic loading rates and short settling times in the AGS technology would reduce the change of bulking phenomena.

Moreover, the volume of residues (as sludge) would be reduced, either if compared to physico-chemical and conventional biological treatments. Note that the sludge production of a conventional activated sludge is around 0,45-0,55 kg/kg BOD and with the AGS technology the number would be 0,1-0,3 kg/kg BOD.

Conclusions

AGS technology is a sustainable and effective system for the treatment of wastewaters generated in the FDM industry. The specific sectors identified for the application (market importance, pollution of streams and new legislation) are the dairy, fish canning, wine production, poultry meat, livestock industries and agricultural sector.

AGS technology would help to meet the new legislation for the FDM industry. In this sense, AGS systems would promote the achievement of BAT7, BAT10 and BAT11 and with an appropriate post-treatment, BAT7 and BAT9.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