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DELIVERABLE D.B.1.2: REPORT OF THE FINAL ADJUSTMENTS OF BOTH PROTOTYPES.

ADNATUR: Demonstration of natural coagulant use advantages in physical & chemical treatments in industry and urban waste water.

CONTENTS

1. INTRODUCTION

ADNATUR project aims to validate, assess and industrially demonstrate a new innovative and environmentally friendly technology. This technology is based on products derived from natural extracts, for its use in the treatment of wastewaters, at urban and industrial level.

After the design and construction of two prototypes, different tests have been done. First prototype is mainly focused on feeding industrial water, in particular textile and ceramics sector. Second prototype is exclusively focused on feeding urban water.

In order to ensure proper performance of both prototypes, real samples coming from the mentioned sectors have been selected to put the prototypes into operation. With this action, problematic points have been detected in order to correct them and optimize the pilot plants as much as possible to avoid malfunctioning of the prototypes in real facilities.

2. INDUSTRIAL WASTEWATER PROTOTYPE.

2.1. DOSING SYSTEM.

Natural based coagulants present a great number of advantages. However, in the pre-industrial phase was detected that the reaction time limits its coagulant efficiency. To avoid this issue industrial wastewater prototype present a specific dosing system where coagulant and water are vigorously blended and simultaneously dosed in order to dramatically reduce reaction time of ADNATUR products.

This system consists in a pipe with a "T-form" with certain slope for better homogenization. This pipe is filled of lamellas in order to use the flow stream to facilitate the mixing and get a proper homogenization between natural based coagulants and water. This way, contact time is increased, avoiding problems in the efficiency of ADNATUR technology. Current design is optimized in order to achieve the greatest mixing performance with the lowest pressure loss possible.

In the prototype, the ADNATUR dosing system will be located before the coagulation tank. A picture of the system is shown as follows:

Figure 1. ADNATUR Dosing System for industrial wastewater prototype.

2.2. MULTI-PARAMETRIC SENSOR.

During the first tests in SERVYECO facilities it was observed that in order to know the efficiency of ADNATUR technology with different product doses, a sample must be collected, then analyzed in the laboratory and with the results obtained (after at least one day) the dose could be modified in order to improve the treatment if necessary. Due to waiting time, ADNATUR technology could be overdosed with the associated costs that this situation implies during a long period of time. In order to avoid that, a multi-parametric sensor was added to the

prototype in order to control the quality of the treated water in situ, just in the outlet water point.

The multi-parametric sensor is a multiple digital controller system that can be programmed to control pH, turbidity, temperature and conductivity. This sensor can be connected to a personal computer for remote controlling and/or programming. The objective of these parameters control is:

- *pH*: ADNATUR technology does not modify the pH of treated water. However, it is very important to control this parameter in order to know if water properties have changed due to modifications in the production line that affects feeding water. Furthermore, the value of pH should be in a range of values, between 6 and 9, in order to discharge the treated water.
- *Conductivity*: As well as pH, ADNATUR technology does not modify the conductivity of treated water. However, this parameter should be controlled for the same reasons that in the case of pH.
- *Temperature*: In a physico-chemical treatment the temperature could affect the effectiveness of the treatment. For that reason, this parameter needs to be also controlled with the multi-parametric sensor.
- *Turbidity*: This parameter is crucial to control the effectiveness of the treatment. In fact, the lower turbidity the better efficiency of ADNATUR technology.

Figure 2. Multi-parametric Sensor for industrial wastewater prototype.

2.3. INTELLIGENT MANAGEMENT.

Nowadays, current physico-chemical treatments are manually managed by the plant operators. This way, outlet water is visually analysed in order to obtain a rapid determination of the treatment quality. In this case turbidity, suspended solids and decantation speed are the

most useful parameters. However, this "analysis" is very inexact and, for that reason, a great number of problems are encountered. For instance, the chemicals dosage is over dosed very often, increasing the outlet values of critical parameters like conductivity and also increasing the treatment cost unnecessarily.

Accordingly, in the proposed prototype the dosing system will be automatically regulated by the control box depending on the turbidity values, perfectly analysized on-line by a specific sensor. As has been mentioned above, turbidity values are crucial for evaluate the efficiency of the treatment. Thus, in the pre-industrial phase several samples coming from the end-user companies have been tested in order to establish a numerical relation between turbidity values and ADNATUR technology doses.

This optimization has the great advantage that ADNATUR products will be dosed depending on the necessities of the feeding water in every moment. Accordingly, the natural based coagulant will not be overdosed and the treatment will be always optimal, reducing costs and environmental issues.

3. URBAN WASTEWATER PROTOTYPE.

3.1. DOSING SYSTEM.

ADNATUR dosing system of urban wastewater prototype is similar to the system used in the industrial wastewater prototype. However, in this case ADNATUR products are focused in a very different application. Most of times flocs formed in a biological treatment are ready to decant and no additional chemicals are required. Therefore, because water flow increase or an incomplete phosphorous removal some coagulant aids, like ferric chloride need to be added before the decanting phase. These chemicals involve a great number of environmental disadvantages like conductivity and sludge volume increase or important pH modification

In these cases, natural based coagulants present numerous advantages. However, in the pre-industrial phase was detected that the reaction time limits its coagulant efficiency. To avoid this issue urban wastewater prototype present a specific dosing system where coagulant and water are vigorously blended and simultaneously dosed in order to dramatically reduce reaction time of ADNATUR products.

This system consists in a pipe with a "T-form" with certain slope for better homogenization. This pipe is filled of lamellas in order to use the flow stream to facilitate the mixing and get a proper homogenization between natural based coagulants and water. This way, contact time is increased, avoiding problems in the efficiency of ADNATUR technology. Current design is

optimized in order to achieve the greatest mixing performance with the lowest pressure loss possible.

In this prototype, ADNATUR dosing system has been mounted between the biological reactor and the conical decanter unit. Photography of the system is shown as follows:

Figure 3. ADNATUR Dosing System for urban wastewater prototype.

3.2. MULTI-PARAMETRIC SENSOR.

In order to have the facility and the treatment always under control, several probes controlling the most important physico-chemical parameters have been installed in the urban wastewater prototype. Most important parameters are described bellow:

a) Dissolved oxygen electrode.

Oxygen is crucial for aerobic microorganism life and grown. Accordingly, dissolved oxygen in the biological reactor needs to remain constant. In fact, when the values are low, aeration system should start to generate oxygen in order to fit the bacteria requests.

For that reason, dissolved oxygen detector is included in the biological reactor. Additionally, it manages the aeration system in order to keep the dissolved oxygen values always in an optimal range.

Figure 4. Dissolved oxygen electrode for urban wastewater prototype.

b) Ammonium-Nitrate probe.

In the nitrification process, previous to the denitrification, the ammonium is transformed into nitrate. Accordingly, in order to control both species an Ammonium-Nitrate probe is absolutely necessary. This way, Ammonium-Nitrate levels help us to determine current efficiency of the process. This probe is additionally able to manage the partial recirculation of the generated sludge, keeping this way the optimal ratio of aerobic / anaerobic sludge in order to optimize the biological efficiency of the plant.

Figure 5. Ammonium - Nitrate probe for urban wastewater prototype.

3.3. MANAGEMENT OPTIMIZATION.

The proper aeration in the biological reaction is a key factor for correct water treatment. Consequently, optimize start and stop of the aeration system that provides dissolved oxygen to the biological reactor is definitely crucial. In addition to that, the optimization procedure avoids unnecessary extra costs.

The concentration of dissolved oxygen in activated sludge processes is considered the most important control parameter in a WWTP. A low concentration of dissolved oxygen affects the microorganisms growth, decreasing the efficiency and, additionally, could cause the appearance of filamentous bacteria. For that reason, when dissolved oxygen electrode gives values under the setpoint, the aeration will start. On the other hand, a high concentration of oxygen is an important energy cost. Keep in mind that the energy cost of aeration can represent more than 50% of total energy cost of the treatment plant. Furthermore, an excess of dissolved oxygen could affect the aerobic process so, when the ammonium-nitrate probe gives values above the setpoint, the aeration will stop. Both for economic and process stability reasons it is desirable to maintain the correct dissolved oxygen concentration in the biological reactor.

Thus, optimization of the aeration system through the dissolved oxygen electrode and ammonium-nitrate probe is a key factor for the proper performance of the urban wastewater prototype.

4. CONCLUSIONS

Optimization procedure of the Industrial and Urban wastewater prototypes has been deeply described. This way, main components with modifications have been detailed in the current report.

With the optimization of the prototypes, most of the possible setbacks have been taking into account in order to reduce them. Thus, start-up time in the facilities is minimized thanks to the previous tests. These tests, allow the prediction of setbacks and its consequent rapid correction during the demonstration phase.