ICONIET 2018

Proceedings of the International Conference on Innovation, Entrepreneurship and Technology,
30-31 October 2018, BSD City, Indonesia,
ISSN: 2477-1538

Function of a Sewage Treatment Plant in Rodgau, Germany

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Abstract: Rodgau has nearly 50.000 citizens and have their own sewage treatment plant. The wastewater of the whole town has to be treated to the point where it can be released in the back which gives the town its name, the Rodgau. There are two main sources of wastewater, municipal and industrial waste water. (www.rodgau.de 8.9.17)

The objective of Sewage Treatment in Rodgau especially is that the waste water after being process can go directly to Rodau river. The drinking water of Rodgau is not coming from the sewage treatment plant. (Bundesministerium der Justiz und für Verbraucherschutz)

The sewage Treatment Plant in Rodgau has the capacity up to 75.000 citizen value (EW). In this sewage treatment there are physical, chemical and biological processes. In the chemical processes there are neutralization, oxidation and reduction processes. The physical treatment including sedimentation, extraction, and adsorption process. Then main steps of the sewage treatment are screening and filtration of the bigger pollutants, transforming of elements and separating the sludge.(ATV-Handbuch (1999))

Different options can be seen which were used in the Rodgau plant. The Rodgau sewage treatment plant is at state of the art, very efficient and can be a great example for sewage treatment plants of other cities.

Keywords: sewage, treatment plant, pollutant

1. Introduction

A sewage treatment plant receives water, which is contaminated with lots of residues of the human digestion. Carbohydrates, proteins, fats, but also urea and endogenous acids are to be found in great quantities. Xenobiotika are also found. Their share is growing continuously. There is more and more hard to non-degradable pharmaceuticals and heavy metals in municipal sewage. How to get rid of those unwanted contaminants is still not completely clear. Since a sewage treatment plant has to operate under real conditions it has to be considerate that all of the relevant processes happen statistically. Therefore, it is not possible to transform **all** particles of a kind or to receive just **one** product from a process. It is not enough to find a fitting method for a problem, but to optimize it in such a way, that the wanted reaction happens prioritized. It is important to note, that nearly all processes at a sewage treatment plant are to be found in nature. Through research it is possible to combine and structure the methods in such a way, that the result is optimal.(ATV-Handbuch (1999)) Right after the pure functionality, a sewage treatment plant as an institution should run as efficient as possible. The economical aspect becomes more relevant since some methods of proceeding difficult substances can be very costly. Also, political issues can decide a lot. Germany encourages renewable energy systems and energy saving methods.

2. Research Method

1. A survey of data was done about the processes an methods of a sewage treatment plant.
2. The plant was observed and each process studied.
3. The maintanance work was done, including tests of the functionality of the processes.

4. Laboratory tests for analysis of the componends in various points were made. Especially of the biological treatment. (according to EKVO- Eigenkontrollverordnung)

3. A sewage treatment plants system

3.1. General Structure

There are three main types of treatment. Physical, biological and chemical. Some processes at a sewage plant use just one of those types alone other combine multiple. It is essential to understand the nature of each type to be able to optimize each process. Every sewage plant has an incoming flow of water and in the end several outgoing material streams. In Germany every plant has specific rules on the structure, volume and composition of each of those material streams. Most important is here the treated water, which flows into the nature afterwards.

High fines can be charged if a plant does not stick to those rules, e.g. Ammonium concentration in off-stream water.(Bayrisches Landesamt für Wasserwirtschaft, (1999))

3.2. Plant process structure

The first step is always a separation of non-soluble pollutants. Waste of different nature shall be separated and treated specifically. Also, fat and sand are separated to get only water with contaminants in colloidal dispersion. Bigger particle sizes could inhibit following processes and harm the equipment. Mostly physical methods will be used in this step.

The next step partly separates sludge from colloidal dispersion and opens a new material stream. From now on two different mass streams are treated parallel. One is mostly water with solved components. The other one is called sewage sludge.

The water now undergoes a biological treatment. Here different components will be transformed into specific compounds. As part of the treatment more sludge forms and is also separated. This sludge will be mixed with the sludge from the previous treatment and given into an own treatment process.

After the process used to treat the sludge water will be returned to the water stream. Water and sludge will mostly be treated with biological methods in this step.

The last step is the most variable one and depends stronger on the specific water and the problems a plant is facing. With mainly chemical methods the water will be treated to the required standard for release.

Every sewage plant has this general structure, the specific methods and processes may differ.

4. Processes in operation

The Rodgau sewage plant has a nearly constant composition of contaminants and good as even flow of incoming water. This is very beneficial for a plants design. In the first separation two screens are used to sieve out big waste, mostly textile and some plastic, out of the water. The other screen is a finer one. It is called bio-sieve. Here leftovers and other small biological pollutants are separated. Both sieves are fully automatic and store the screening material in two containers.

Now a so-called sand trap separated sand and fat with a physical method. Sand, heavier then water and fat, lighter then water will settle down (sand) or refloat (fat) here. A horizontal pool uses special water whirls to benefit this separation. Sand will sink to the ground where it can be recovered in intervals. The fat will be pushed under a physical barrier and therefore separated from the main water flow.

Now the first sludge will be gathered with a sedimentation pool. A horizontal pool let water flow through very slow. The sludge will settle down and can be pumped out in a set time interval. The biological method used is to treat the water. In big round pools the water is treated with special bacteria under aerobic and anaerobic conditions. The pools can be labeled as biological reactors. Specific conditions must be made continuously. The available air, the movement in the water, pH-value, temperature and approximate number of bacteria to name the most relevant. In nearby pools

the water then is separated trough sedimentation again from most of the sludge. The sludge is treated with the sludge from the pre-treatment together.

The sludge is gathered and filled into sedimentation tanks to reduce the water content. The water separated from sludge is called process water and highly contaminated. It will be treated in a step later on. The sludge is treated in a digestion tower. Here, rot processes transform nearly all biological compounds. A lot of Methane and Carbon dioxide is formed. Due to the high damaging potential to the atmosphere and potential energy in this gas mixture it will not be released into the nature. It is pumped into a storage. The sewage plant Rodgau has a combined heat and power plant engine. It used the biogas as fuel to provide heat and electricity for the plant. *Note: Since Germany has temperatures far below 20° C sometime a lot of heat is needed for the digestion tower and the biological treatment.*

Afterwards the sludge is separated from most of the water with a combination of two steps. First another sedimentation and afterwards a centrifugation with flocculation.

Here again a lot of process water is collected. The dried sludge is now gathered in containers.

The Process water is treated in a reactor similar to the biological reactors the water is going into. Here different bacterial strains are used. The conditions can be controlled better, and the highly contagious and contaminated water undergoes intense treatment.(B. Wett und M. Hell) The products are sludge and water streams which will be added in the drying for the sludge and at the begin of the biological treatment for the water.

In the last treatment step, acid and base is used for neutralization. This is usually not needed in great value. If the incoming water has some abnormalities this step can stop dangerous substances before they can get into the nature. Other chemical can be injected in the water flow for that purpose also.

5. Off-going Material streams

There are four mayor material streams going off the plant. First the screening material. Here the fat from the sand trap is added. Both containers will be brought regular to an incineration plant. The material will undergo combustion which will produce current at the plant.

Depending on the quality of the sand it is usually sold to a company which uses the sand for building purposes, like street fundament, or concrete ingredient.

The dried sludge can now be used in several ways. In the past it was used in the agriculture as fertilizers. Since there is to be found more and more products like medicine and the like this is no longer an option. It will be used in a special thermal treatment plant which will also produce current from a combustion. (M- Grömping 2003)

The last and most relevant stream here is the treated water. It has no drinking quality since it has been traces of bacteria left. The water is free from harmful substances for rivers. Natural processes will further change the water in the river and close the water cycle.

6. Conclusion

The sewage treatment plant Rodgau is at state of the art. They use modern and efficient methods at every point. Three people can maintain the whole plant in regular operation. With solar panels on the roof and the biogas system, a lot of the needed electrical energy can be produced at the plant itself. Through intelligent combination and organization as well as cooperation contracts, e.g. with thermal treatment plants the dangerous, yet still energy containing material can be used for current production. Waste treatment and energy recovery are combined here very good. New methods for treating new components, e.g. hormones and medicine traces, are tested and will be implemented in future days.

Due to the efficient operation at every point this plant is very cheap compared to others with the same results. An efficient structure does not benefit the process alone, but the economical expense of the city directly.

ISSN: 2477-1538

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