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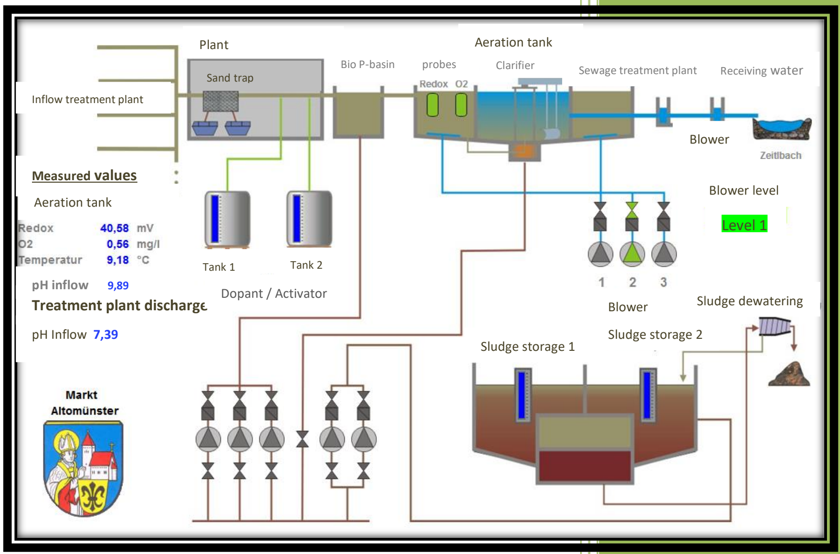
CONSULTANT ENGINEER

2010

The treatment plant of the future



Project of the Shieer Group
Biotechnological support
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Structure

A. Introduction

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Technical treatment plants are an invention of the 19th century. Nevertheless, ancient cultures already built sewers. In Mohenjo-Daro in Indu in today's Pakistan, a sophisticated canal system was built 5000 years ago.

In our culture, the Romans and Greeks were exemplary pioneers. For the palace of Knossos in Crete, in the 2nd millennium BC Chr. drainage channels built with clay pipes. Far more famous is the "Cloaca Maxima" from ancient Rome, which supplied the wastewater to the Tiber in the form of a four-meter-high vaulted canal. In the Middle Ages, then came the dark times of wastewater treatment.

Old sewerage techniques are forgotten. The conditions in almost all European cities were catastrophic. The sewage treatment system experienced a renaissance only in the 20's of the last century when increasing water pollution became a serious problem. For this reason, wastewater treatment is an up-to-the-minute issue, because even today's plants still give rise to improvements, as the following explanations show.

I. Initial situation

1. Timed ventilation

The supply of bacteria with oxygen is usually time-controlled in sewage treatments, that means it is ventilated in a predetermined on-off cycle. The disadvantage of this widespread procedure lies in its inflexibility. If only small amounts of nutrients flow through the wastewater, as it’s usually the case at night, the oxygen content in the water during aerating increases up to 5 mg/L. That’s a huge value. Because the microorganisms only need about 2 mg / L of dissolved oxygen in the water for an optimal nitrification process. The result is that the residual oxygen gets again released unused to the environment. Since the ventilation process requires a considerable amount of energy, the associated costs are not insignificant but unnecessary. The opposite is true when frequently individual load peaks of nutrients occur in the wastewater. Due to the limited switch-on times, it may sometimes happen that the oxygen is not sufficient for the nitrification process. As a result, not completely purified wastewater can leave the activated phase and be introduced with considerable residual contamination of ammonium, nitrate and nitrite in the receiving water.

2. Inadequate biology

The main assets of a sewage treatment plant are the cultures of their microorganisms in the aeration tanks. These cultures consist for the most part of specialists that means from tribes that have a much longer doubling time, like the generalists who do not perform any specific degradation activities.

The most important microorganisms are:

- Nitrosomonas, which count with their chemolithotrophen lifestyle to the nitrite bacteria. They are responsible for the first step in nitrification, in which the oxidation of ammonia to nitrite occurs.
- Nitrobacter, which represent the second step of nitrification. They belong to the genus of nitrate bacteria. Their metabolic activity lies in the oxidation of nitrite ions generated by Nitrosomonas to nitrate ions (NO_3^-).
- Pseudonomads or paracoccus, which accomplish the final work-up to elementary N, denitrification. This takes place in the anoxic area, under oxygen deficiency. The microorganisms convert the previously generated nitrate into elemental nitrogen in several steps. The elemental nitrogen is gaseous at temperatures prevailing in a sewage treatment plant and is therefore released to the atmosphere.

The microorganisms belong to the so-called psychophile microorganisms. Their metabolic optimum lies in a temperature range between 12 ° C and 15 ° C. During the winter months, the water temperatures in the aeration tanks sinks to 4 ° C, which means that basically no more metabolic processes are taking place and therefore no more nutrients are getting reduced. The biological stage of sewage treatment plants is therefore largely without function during the cold season. For good reason, therefore, no measurements of effluent values are required by the water management authorities at these times.

3. Data monitoring on site

Many municipal sewage treatment plants have an information center at the sewage treatment plant, where all relevant information converges. They are randomly monitored by the treatment plant masters. If necessary, the systems are readjusted. However, this monitoring can only take place if appropriate specialist personnel are on site. Problematic are disturbances that occur at night or at weekends. Although in most cases there is an alarm via mobile phone, e-mail, etc., but for error assessment or troubleshooting the employee must be on the spot, which may not always be easy.

4. Danger of mud output due to missing barriers

Mud output means the „GAU“for biological wastewater treatment plants.

Mud output means the "GAU" for biological wastewater treatment plants. If a mud take-off takes place in the receiving water, the specified limit values are usually exceeded by a multiple. The biggest problems of a treatment plant master are that sludge drifts are not foreseeable, especially from secondary sedimentation. He has virtually no opportunity to preventively intervene in any way. In order to prevent an output or to build suitable barriers, appropriate measures must be taken to ensure that no sludge residues in the receiving water and thus reach the environment.

5. Degradation of phosphate

The phosphate precipitation is a physical / chemical reaction in which the phosphates with salts trivalent metals are precipitated. In the process, the toxically questionable
Aluminum salts used. By introducing the metal salts, positively charged metal ions are formed which react with the negative phosphate ions. The resulting poorly soluble metal phosphate is precipitated in the form of very fine flakes.

PO_4^{3-}	+	Fe^{3+}	=	$FePO_4$
Orthophosphate	+	Trivalent iron-ions	=	Iron phosphate as precipitation

The precipitant must be added quickly at a suitable location to allow the ions to react sufficiently with one another. This is followed by a flocculation phase in which the fine precipitation products can aggregate to form settleable flocs.
The biological phosphate elimination is the ability of certain bacterial cultures beyond a normal level to take up phosphate and store it in the form of polyphosphates in the cell structure. This condition is triggered by a clever interplay of anaerobic and aerobic states to which the microorganisms are exposed. Anaeroby exposes the bacteria to a stressful situation because there is no oxygen left. They compensate for this problem by using the stored phosphates as their current energy supplier. If the microorganisms then return to an aerobic environment, they store more phosphate due to the stress situation than before.

Many sewage treatment plants with Bio-P basins use these two phosphate elimination processes at the same time, but in most cases due to various factors, their function is not or only partially fulfilled.

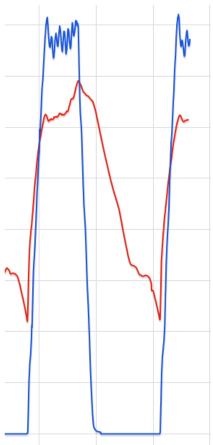
The aluminum salts used are basically nothing but waste products from the industry. Helpful for the chemical phosphate precipitation are only the iron (III) salts.
The aluminum chloride, which is also present in different concentrations, it's actually a cell poison and should not be in contact with humans or introduced into water.

Shieer Eisenchelat
Safety data sheet according to 91/155 EWG
In the version dated 2001/58/EG see appendix

II. Our concept "Stage I" (process optimization)

1. Load-controlled ventilation / redox measurement

Our first measure is a departure from a timed to a load-controlled ventilation, which then ventilates when there is a need for it, so there is a consumption. The presence of nutrients is detected by a redox measurement, whose operation is briefly explained:
The redox measurement takes place by means of an additional probe built in by us, which allows a more reliable operation than the previous orientation on the oxygen value. The redox value indicates how much oxygen is in undissolved / dissolved form in the clarifier.



This chart shows how the nitrification / denitrification phase works. The red curve is the redox curve, the blue curve, the value of the dissolved oxygen in the wastewater. At the beginning of the aeration, the oxygen value increases, which from a value of 2 mg / l O2 through a frequency-dependent control of the "blower" tries to keep the dissolved O2 content in the water constant until the redox curve has reached a previously set value. The duration of this aeration process depends on how high the degree of pollution of the wastewater is, i. How much oxygen is consumed in the pelvis. Now that the set redox value is reached, which means that no more consumption takes place, turn off the fans and the dissolved oxygen in the water drops. The transition from the aerobic to the anoxic phase takes place, in which the denitrification begins. This condition persists until neither anoxic nor undissolved oxygen is in the medium. The transition to the anaerobic region can be seen on the nitrate knee, which states that all bound nitrogen was reduced to elemental, gaseous. At this point the ventilation starts again and the procedure starts again.

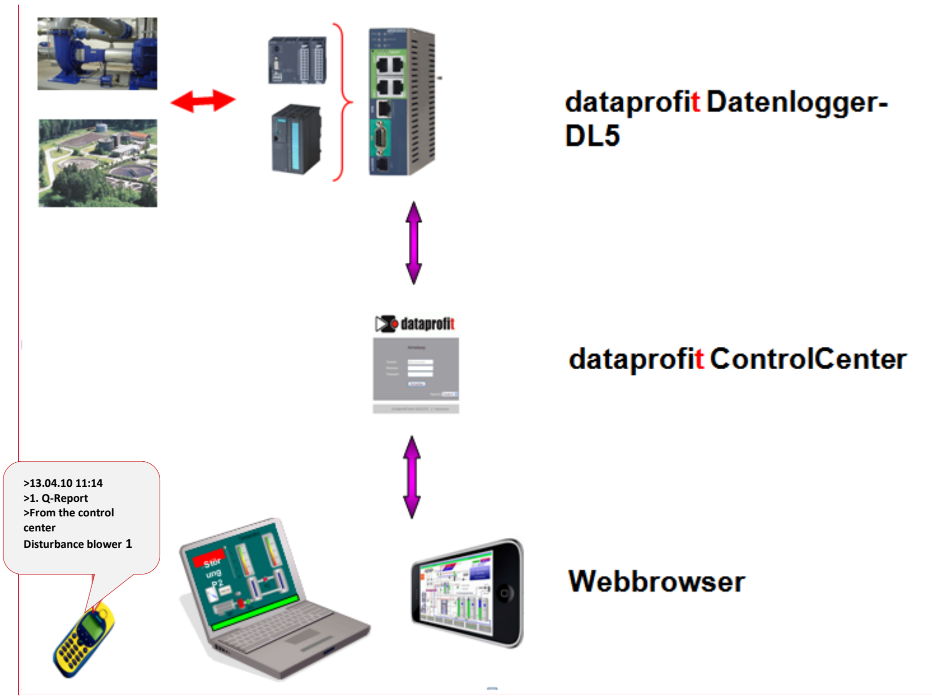
The advantage of this process management is that we are no longer subject to time-controlled ventilation, which has always been ventilated for the same length regardless of the degree of water pollution. The load-controlled aeration by the redox probe adjusts the aeration times precisely to the consumption, that means the degree of water pollution and thus shortens the average running time of the fan to about 60%.

2. Addition of SHIEER BWC

BWC is a pure plant-based product that acts as an activator for our biocultures, accelerating enzymatic and catalytic control in the biological transformation process. Through the use of these cell stimulators, we achieve an optimal environment, which creates excellent growth conditions for the required, special microorganisms whose generation time is much longer than other bacteria such as E. coli. As a result, such microorganism strains must also be maintained, as they are in constant competition with much stronger but less useful populations. Through these activators the vitality of our biocenosis is increased so that the ecological niche is not endangered by other germs. Furthermore, processes are observed that were not possible according to previous biochemical knowledge. An example of this is the amazing result that in January of this year with two-digit minus temperatures and a water temperature of about 5 ° C best expiration values for nitrate and ammonium nitrogen were to be measured, although these psychophilic organisms strains at temperatures below 8 ° C allegedly their degradation capacity hardly until can not perform at all. Another argument for BWC is that, in addition to promoting beneficial microorganisms, it inhibits pathogenic nucleation or hydrogen sulfide-forming bacteria. These bacteria have a strong corrosive or damaging effect on the substance of the entire sewage treatment plant. Furthermore, it has been proven that these biocatalytically active agents are 100% biodegradable, which only confirms the ecological aspects even more. BWC is not a panacea, but the necessary addition to create the basis for achieving discharge values that are ecologically acceptable from today's perspective and not the antiquated notions of politics whose limits are in disparity to our responsibility to future generations.

3. Information processing

With the data logger dataprofit-DL5 we can read data from all common PLC controls without changing their programs. If necessary, we can change control values and parameters directly over the distance. The data logger DL5 is very flexible and has a very good price / performance ratio. The decisive advantage of our system lies in the fact that we can evaluate the measured values at a central location and visualize them on the Internet through the ideal coordination with the measuring and control technology installed in the system. You have the ability to view the data from any point of view worldwide. Conversely, there is also the opportunity to change manipulated variables on any PC or smartphone with Internet access, provided that the authorization exists. As a result, the sewage treatment plant manager no longer has to be on site to observe a plant and, if necessary, intervene in a controlling manner. But that will usually not be the case. Because of the load-dependent redox control, the system is normally controlled automatically. For alarm messages, however, it is important that the causes are immediately visible from the nearest PC or smartphone and the problem can be initiated targeted.



Kommentiert [u1]:
Kommentiert [u2R1]:
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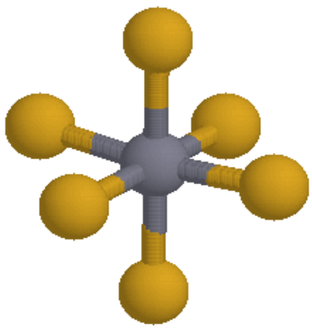
4. Biofilter

The biofilter is switched between secondary clarifier and receiving water. It serves as additional purification and by its overflow protection it prevents dirt from getting into the receiving water when the sludge is discharged. The functioning of the biofilter is like a fixed-bed reactor in continuous operation (continuous culture). The reactor consists of a cylindrical stainless-steel construction (1.4301). It is filled with lava stones and sand of different grain sizes. These well-defined fillers result in a filter function that prevents flocculated flakes from entering the receiving water. The second function is that of a fixed-bed reactor. The porous lava rocks are home to microorganisms in the form of biofilms, which break down the last contaminants in the water. By these microorganisms even a sterilization of the water takes place. The result is that after the biofilter water in the best drinking quality flows into the receiving water.

6. Phosphate precipitation

Chemical phosphate degradation by pure ferric chloride and SHIEER iron chelate.

Unlike to the traditional chemical phosphate precipitation, we do not use any industrial waste that may be heavy metal contaminated. Under no circumstances should these substances enter drains or waterways. Originally additions of several ten L / hour were the rule. We usually dose by a factor of 3 to 5 times less than before. This is because the addition of SHIEER iron chelate results in complex formation. A complex formation consists of a central atom, in our case the iron chelate and the so-called ligands, the orthophosphate. This compound has the advantage over normal salt precipitation that once bound it does not dissociate again in the water. The advantage here is obvious. The product appears to be substantially more expensive for the first time, but is cheaper due to its lower consumption and, in contrast to iron-aluminium chloride, is not harmful to the environment.

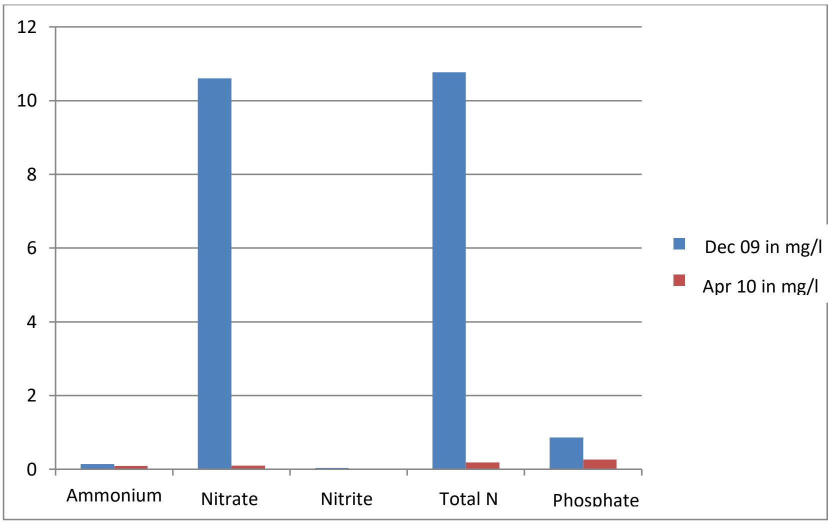


III. Advantages of the planned conversions

1. Ecological aspects

- High quality of purified wastewater using the example of KA Altomünster
- At about the same water temperature

	December 2009 in mg/l	April 2010 in mg/l
Ammonium	0,140	0,091
Nitrate	10,6	0,093
Nitrite	0,032	0,002
Total N	10,772	0,186
Phosphate	0,86	0,258



- CO_2 relevant energy savings. The CO_2 savings can be up to several tons over the course of a year.

- Reduction of the odor load on the treatment plant to a level that is no longer perceived as unpleasant.

2. Economic aspects

- Reduction of energy consumption in the biological stage by up to 20%, depending on the previous mode of operation.
- Excellent discharge values can be applied for exemption from the sewage charges. Depending on the amount of the previous expiry values, this can result in considerable cost savings.
- As a result of increasing the efficiency of biology, the amount of sewage sludge is reduced by up to 25%. Considering that up to 25% sewage sludge needs to be less dewatered and disposed of, this results in another not inconsiderable cost reduction.
- Higher plant life. Less corrosive damage due to H2S-forming bacterial strains. Such colonies are strongly inhibited by our additives in their development.
- Expensive construction projects for the extension or the new construction of an additional wastewater treatment plant may be superfluous. Municipalities can join together to form wastewater associations and share existing facilities. This results in only the costs for the wiring, and a possible hydraulic upgrade of a wastewater treatment plant, which is much less capital intensive than a new building.

IV. Estimated costs for the conversion "Stage I" using the example of Altomünster

1. Total investment costs

Lfd. Nr	Product name	Short discribtion	Amount	E-Price	G-Price
001	Measure control rules + online telecontrol	- Redox measuring probe - Oxygen measuring probe - 2 level sensors - Control unit - Database	1	38.900.-	**38.900.-**
004	Tube dosing pump	- Addition of Ferric chloride and SHIEER iron chelation	2	850.-	**1.700.-**
005	Dosing tank	- 1000 l container for storage and use of SHIEER BWC	1	1.000.-	**1.000.-**

006	Monitoring by WWA	- Installation of a phosphate analyzer and an ammonium nitrate probe	1	22.000.-	**22.000.-**
007	Bypass container	- 6000 l stainless steel container with matching connections - Installation of the tank including wiring and installation of an MID	1	14.500.-	**14.500.-**
008	Feed pump	- To make the bypass between the reactors and the Bio-P basin	1	500.-	**500.-**
009	Biofilter	- Biofilter with overflow protection and claw compressor to ensure a permanent backwash	2	30.000.-	**60.000.-**
010	Mounting	- Installation of biofilter including compressed air connection and earthworks	2	15.300.-	**30.600.-**
011	Planning	- Engineering services and planning of the entire restructuring	1	19.000.-	**19.000.-**

Total costs plus VAT : 188.200.- €

2. Ongoing higher operating costs

Lfd.Nr.	Product name	Short discribtion	Amount	E-Price	G-Price
012	SHIEER Bio Water Clean	Enzymatic activators	700 l	50.-	35.000.-
013	SHIEER Eisenchelat	Complexing agent for supporting phosphate precipitation	10 l	100.-	1.000.-
014	Iron-(III)-chloride	Salt formers for chemical phosphate precipitation	10 m³	250.-	2.500.-

Total Costs plus VAT: 38.500.-

3. Saved investment costs based on the example of Altomünster

The savings that result from the upgrade of the wastewater treatment plant in Altomünster must be estimated at several million € uro. However, a detailed list is omitted, as the exact amount is irrelevant to our intentions. Of great importance is only the scale in which we are. For this reason, we estimate the savings estimated at 3,000,000.- € uro

Lfd. Nr.	Product name	Short discribtion	Amount	E-Price	G-Price
015	Electricity	Energy efficiency is improved by 40% compared to 2009	75.000 kWh	0,14	10.500.-.
016	sewage sludge	It will be less drainage action than 2009	-----	--	22.000.-
017	Waste water charges	Due to the explanation of lower values, saving per year in the levy	-----	5.000.-	5.000.-
018	Iron-aluminum chloride	Exempted by the addition of pure iron chloride and chelate	75m³	60.-	4.500.-

Total savings plus VAT: 42.000.-

Lfd. Nr.	Product name	Short discribtion	Inputs and outputs	Sum
019	Investment costs	Measures required for the conversion	-	188.200.-
020	Saved investment costs	Structural measures, which are eliminated by the upgrade	+	3.000.000.-
			∑	**+ 2.811.800.-**
021	More operating costs	Required resources for the optimized process	-	38.500.-
022	Saved operating costs	Saved energy and resources	+	42.000.-
			∑	**+ 3.500.-**

5. Point of view

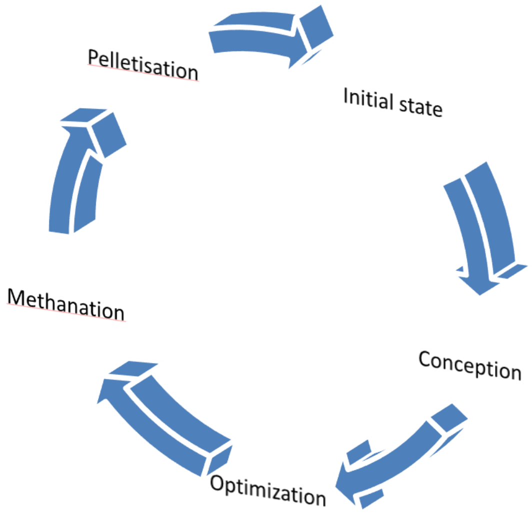
Of course, this calculation has an enormously positive result due to the thus saved construction of another wastewater treatment plant in Thalhausen. It should be noted that the Altomünster example is already a very well managed facility in the district of Dachau. Other municipalities may not be able to count on new construction, that is no longer necessary but may have to contend with significantly higher wastewater charges or more inefficient nitrification phases. From this it can be concluded that values must not be considered absolute, but must be considered individually by us, depending on the size of the installation and the type of property.

V. Why us?

1. Interdisciplinary cooperation

Why we will succeed with this concept!

Our advantage is clearly in our holistic approach and in our interdisciplinary competence. We try to solve the problem as a whole, with the currently best possible means from various fields. Our concept is well thought out and comprehensive. It does not solve a problem by creating a new problem elsewhere and there are no issues and desires left open. The sewage treatment plants designed by us are ideally equipped for the future. Another benefit of our work is that we do not achieve the savings at the expense of the environment. But on the contrary. Our business model is geared towards absolute environmental protection as well as economic concerns. Through this approach, we have succeeded in converting the wastewater treatment plant of the future of an undesirable cost factor, which is often hushed by many communities, to an economically and environmentally active factor. The generated company will try, from an ecological as well as economic point of view, to make the best possible use of its scarce resources and thereby achieve a balanced wastewater budget. Given the current level of wastewater charges in most communities, this aspect could become a real locational advantage that is well received in the local selection of commercial and residential buildings.



VI. Our concept "Stage II"

1. How methanation works

The methanation usually takes place in a 4-stage process in which the proteins, fats, carbohydrates, etc. are degraded.

1. Hydrolysis
   The polymeric macromolecules can not be taken up by the microorganisms directly into the cell. By excretion of various exoenzymes such as amylase, lipase or protease, the hydrolyzed macromolecules are broken down into their soluble monomers. Fats are hydrolyzed to fatty acids and glycerol, proteins to peptides or amino acids, and carbohydrates into monosaccharides.

2. Acidogenesis
   Now, the fragments formed in the hydrolysis can be absorbed by so-called transport proteins into the cells of the microorganisms. The degradation processes occurring in the cells now decompose the products of the hydrolysis further to carboxylic acids,

lower fatty acids such. As acetic acid or butyric acid and the unusable products carbon dioxide, hydrogen and hydrogen sulfide.

3. Acetogenesis
   During Acetogenesis, the lower fatty and carboxylic acids and the lower alcohols durc h acetogenic microorganisms converted to acetic acid (acetate).

4. Methanogenesis
   In the last mandatory anaerobic methanogenesis, methane is produced from the acetate or from carbon dioxide and hydrogen.

Equation 1: $CH_3COOH \rightarrow CO_2 + CH_4$
Equation 2: $CO_2 + 4\ H_2 \rightarrow CH_4 + 2\ H_2O$

3. Efficiency

The operation of the methanisation plant in Altomünster requires around 10,000 cubic meters of sewage sludge per year. This corresponds approximately to a wastewater treatment plant size of 18,000 pe. Of course, it is clear that these investments are not suitable for all municipal sewage treatment plants. But that is not the intended goal. Our aim is to build so-called methanisation bases for certain areas, in which the surrounding communities can bring their sewage sludge to cost-effective disposal. Considering that one cubic meter of sewage sludge from drainage to incineration incurs considerable costs, the price of our alternative is negligible. There are only costs for transport from the surrounding sewage treatment plants to Altomünster.

VIII. Our Concept „Stage III“

In the third optimization phase, which starts at the same time as the second one, the fermentation residues from the methanation are processed into fertilizer pellets. The pellets are strongly phosphate-containing due to our chemical precipitation. Phosphate is a vital substance for plants and a limiting factor for growth. Therefore, it is important to recycle and recycle such raw materials. Especially because the worldwide phosphate deposits, which are not mixed with uranium-containing material and are highly limited. For these two optimization processes, which of course follow the first one in a timely manner, you will, of course, once again be cordially invited by us.