A freight train full of energy

23.03.2023

Editorial on the topic ”ENERGY AND SUSTAINABILITY” by Prof. Dr. Franz Bischof

”Energy”! A word that electrifies and invites discussion like no other at the moment. Everyone in this country now knows about the importance of energy – and its availability and costs. And it is energy carriers, heat and electricity, i.e. the conversion products of our technical processes that are subject to losses, that keep our lives and those of industry in this country “running and alive” and at the same time make them easier.

Energy transition: Energy can be generated from wastewater in an innovative and sustainable way.

1,000,000 billion joules of primary energy consumption

But have you ever actually thought about how much energy is needed in Germany every year? According to the latest figures from the Working Group on Energy Balances from September 2022, Germany has a primary energy consumption of 12,413 petajoules. That doesn't sound like little – and it isn't. Peta represents the figure 10 to the power of 15, or put more simply: 1,000,000 billion. Such huge numbers are completely beyond our imagination and mental images are needed to grasp their significance.

A 78,191-kilometre freight train

Let us imagine, then, that this primary energy in the form of hard coal would have to be transported to Germany by a freight train. The freight wagons usually used for this purpose have a payload of 65 tonnes and a length of 12 metres. It would be a long freight train: consisting of a good 6.5 million wagons or a total length of 78,191 kilometres! Every year we empty this “special train to Germany” twice around the earth's equator. Households, transport and industry share the final consumption more or less equally – about 20 % each. And almost as much primary energy, almost 18 %, is lost through the conversion of primary energy into final energy.

Saving energy, recovering energy and new forms of production

Saving energy wherever possible, recovering it and finding new forms of energy production is therefore the top priority as long as it is not possible to substitute primary energy consumption from predominantly fossil energy sources with regenerative energy sources on a large scale.

Wastewater contains chemical and thermal energy

Wastewater seems to be a very interesting medium for this and could make an important contribution. On the one hand, wastewater contains chemically bound energy that microorganisms can release in anaerobic processes in a controlled manner in the form of the energy carrier methane. On the other hand, the thermal energy stored in wastewater should be of great interest. Per degree Celsius, one cubic metre of wastewater has the energy quantity of 1.16 kWh. This means that wastewater could theoretically replace 1 cubic metre of natural gas if 1000 litres of it were cooled by about 9 degrees Celsius through heat extraction. Heating with wastewater instead of natural gas!

Using high energy potential through adapted heat exchange systems

Such applications in the area of municipal sewers are unrealistic, however, because this would impair the purification process at the sewage treatment plant too much. Cooling by 1 to 2 degrees, however, is usually no problem and even on this relatively small scale has a high energy or heat potential. However, it is not uncommon for wastewater or process water to be produced at relatively high temperatures in municipalities or in industrial production processes. In future, it should no longer be possible to do without this energy. However, efficient heat exchange systems that are adapted to the special features of wastewater are the technical prerequisite for this goal in order to be able to create sustainable heat utilisation concepts for the respective case.

The future of energy-recovering and energy-efficient processes and products

In the overall view of wastewater technology, the future of energy-recovering and energy-efficient processes and products did not just begin yesterday. The use of waste heat from wastewater is becoming more and more established; electric drives with improved efficiency are being used more and more. New wastewater treatment processes aim to remove organic matter from wastewater in the influent of wastewater treatment plants in order to produce more methane in digesters and at the same time reduce the energy required for the aerobic treatment processes in the wastewater treatment plant.

New and innovative monitoring processes to detect excessive wear on machinery are being developed as part of the advancing digitalisation to detect unnecessary energy consumption at an early stage. In addition, digitalisation in combination with intelligent

evaluation of data opens up completely new possibilities for optimising processes: for example, less sludge accumulation and lower precipitant consumption. While these benefits may not be recognised as energy-saving measures at first glance, they are still a major challenge.

Intelligent design, lightweight materials, quality and durability

At second glance, however, they show up in the reduction of chemicals and transport, or in other words: saving energy by “not producing” and “not driving kilometres”. Intelligent design of machines or the choice of lightweight materials with the aim of reducing weight are also directly related to the saving of energy for production and transport. The high quality of products and, consequently, their durability, in turn, form the basis for the economical use of raw materials required for their manufacture. Product quality should therefore always be seen in a positive context with energy saving.

The technical symbiosis of energy and sustainability

Many of these examples show that the responsible use of energy is inseparably linked to sustainable wastewater technology. Energy and sustainability have come together to form a remarkable technical symbiosis. From this perspective, wastewater technology in all its fields of application will also be able to make an important contribution to shortening our "freight train full of energy" in the future. You just have to do it, according to the saying: "Doing is like wanting, only more intense!”

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