Save energy, environment, health, and money by producing energy-rich biogas and energy-rich biofertilizer

By Ruzena Svedelius DrAgr 2022-05-28

From the beginning, I was interested in better understanding how we should handle plant nutrition. When I was a teenager living in Czechoslovakia, there was a lot of talk about hunger, and I wanted to save the world by gaining more knowledge. I got the opportunity to do research when I finished my studies for a master's degree in horticulture at the Swedish University of Agricultural Sciences.

My supervisor suggested that I do research on composting and my dissertation, and some publications can be found on http://biotransform.eu/history/

1997 Product-Oriented Composting. From open to closed bioconversion systems. Thesis 1997 part 1; Thesis 1997 part 2

1997 Methods for Laboratory Studies on Composting Laboratory Studies on Composting-Ruzena Gajdos

1998 Resource, Conservation and Recycling 23 (1998) 67-86 Bioconversion of organic waste by the year 2010 RG-RS – On page 78, there is a proposal for digitization of the system that handles organic material from households. On page 80 compares four methods of bioconversion of Renewable Organic Materials.

Therefore, I dare say that we should stop advocating composting. In most cases, we get from 100 kg of raw material, after a few months or years, about 30 kg of compost of uncertain quality. Can we afford to lose 70% of the raw material?

For precision composting in bioreactors in the laboratory, I received 85% product in less than 2 weeks, but since the product had a low fertilizing effect and was rather soil improvement, it would be costly to do composting in bioreactors on a large scale. If there is interest, I can give a deeper explanation.

My interest in biogas began in 1991 when I was invited to a full-scale project in Czechoslovakia in May. Solid raw manure from 400 cows was used as raw material. A few months later, I met professor of microbiology Hans Ljunggren and asked him why people in Sweden use water-borne systems when it is possible to use higher levels of dry matter. He replied: "It is a technical way of transporting organic material, but it is not optimal for microbial conversion." I asked what is optimal? "Much like you have in the compost," he replied. This means that the optimum is about 30% dry matter.

I contacted the AD research leader at Lund University, but he declined to cooperate with the words: "We work for the pharmaceutical industry, we are not interested in working with shit." A few years later, he used sewage sludge in his research.

In 1995, I met a conference researcher Christofer Rivard from NREL in the USA and was invited to visit their laboratory where they researched High Solid's Anaerobic Digestion (HSAD). Money came from the oil industry when it started talking about "peak oil". When I got the opportunity to get there in 1996, the research had started to end because the oil companies realized that everyone could make biogas and the companies would lose their power.

Rivard's and his colleagues' publications are very interesting, but even if I had the opportunity, I would never have worked with sewage sludge as a raw material, which I will explain later.

Unfortunately, much more than in Anaerobic Digestion (AD) is still invested in unsustainable methods which rarely reports that
a) all organisms living on and in the raw material are killed and biodiversity is reduced
b) plant nutrients are lost and cause emissions that pollute air, water, and soil

c) the magnitude of negative effects on the rest of society is greater than the positive ones. These are incineration, thermal gasification, pyrolysis and chemical conversion of Renewable Organic Material (ROM). Composting is also an unsustainable method which, in addition to losses of about 70% of the weight of the raw material, creates emissions that pollute air and water. Technology that is adapted to the needs of microorganisms called Optimum Solid's Anaerobic Digestion (OSAD) did not receive any funding so far.

In principle, everything undergoes microbial transformation - even rocks - it is only a matter of time. To obtain a high yield of biogas and biofertilizer that is adapted for sustainable cultivation in forestry, agricultural and horticultural companies, technology is required that enables appropriate pre-treatment of raw materials and bioreactors where a number of different factors can be monitored and controlled.

There are many options for managing sustainable raw biogas. On the other hand, the production of various biofertilizers from digestate, that are adapted to the needs of the crops, needs to be further developed. Precision at all stages from the raw material source to OSAD and subsequent use of biogas and production of suitable biofertilizers is required just as with all other processes.

Although I have received countless rejections of applications made with like-minded people, I am willing to apply for grants for innovation projects that will use knowledge from both research and practice to design sustainable management systems of waste and residues originating in plants, animals, and microorganisms and which should be called Renewable Organic Material (ROM) unlike Fossil (FOM) and Synthetic (SOM).

To be an equal partner in innovation projects, my partner Birger Sölverud transformed his individual company “BAS konsult” into a limited company “BAS-konsult AB” during the autumn of 2021.
First now are we starting to act because I got sick, had surgery, and was treated with chemotherapy. I have been given a second chance, so we will spread information about the fantastic opportunities that local management of ROM with OSAD brings.

BAS-konsult AB proposes that food and toilet waste be mixed with other types of Renewable Organic Material in municipal waste or in residual products from forestry, agricultural or horticultural companies to obtain a suitable substrate for microbial conversion to biogas and biofertilizer in local high-tech biogas plants.

The BAS-konsult AB considers it illogical that the "legal framework in the EU" allows the use of sewage sludge as a raw material for biogas plants and prohibits the use of urine, faeces and toilet paper collected at the source.

Currently, about a third of food waste and toilet waste are first diluted with clean water and then mixed with other types of wastewaters that contain many different chemicals - including PFAS. In wastewater treatment plants, nitrogen is sent with a very expensive method to the air which is polluted with nitrous oxide (N2O). Consider the following statement from the United States: "Municipal sewage treatment plants spend on average more than $ 140 to remove a pound of nitrogen."
Residents pay to send nitrogen to the air in wastewater treatment plants and growers must buy mineral nitrogen from abroad, which is produced from air nitrogen using an energy-intensive method. It is said that about 2% of all energy in the world is used for this process.

Some more facts about nitrogen (N)

- Emissions of nitrogen compounds have crossed the planet's boundaries.
- Each resident leaves about 5 kg of nitrogen per year in the toilet in urine and faeces. There is no estimate of how much nitrogen comes to wastewater from food waste, the food industry, and other industries.
- Most of the nitrogen is sent to the air as nitrogen gas “free nitrogen” (N_2) in sewage treatment plants during nitrogen reduction - which is denitrification - but in Sweden there is no account of what it costs per kg of nitrogen. According to information from the USA: "Municipal treatment plants spend more than $ 140 on average (about 130 euros or about 1,368 SEK) to remove a pound of nitrogen."
- Up to 11% nitrogen can be converted in sewage treatment plants to nitrous oxide (N_2O), which is greenhouse gas about 300 times stronger than carbon dioxide (CO_2)
- The sewage treatment plant for 340,000 inhabitants in Sweden emits 481 tonnes of nitrogen per year into the sea. This means that about 1.4 kg of nitrogen per person per year goes with "purified water" to watercourses and the sea.
- A combined heat and power plant that uses 310,000 tonnes of fuel “bark, peat, wood chips” releases more than 500 tonnes of nitrogen into the air, which forms nitrogen oxides NO and NO2, which damage our lungs. Therefore, these materials should be mixed with nitrogen and aqueous materials instead of using water as a means of transporting food and toilet waste and animal excrements.

All the way from the kitchen and toilet to the production of sewage sludge in wastewater treatment plants, food and toilet waste loses much of their bioenergy and the vital chemical elements H, C, O, N, P, K, Ca, Mg, S, Cl, Fe, B, Mn, Zn, Cu and Mo which were present in these materials from the beginning. Present sewage systems cause pollutants that negatively affect the environment, health, and climate.

Using hygienically collected food waste, urine, faeces, and toilet paper, encapsulated in foil of various biomaterials, as raw material to produce biogas and biofertilizer leads to a radical reduction of emissions that today pollute air and water, reduced costs for diseases, water consumption, wastewater treatment, purchase of mineral fertilizers, etc.

The most positive thing is that it provides an opportunity to - in local high-tech biogas plants in a sustainable way - take advantage of
a) **bioenergy in the form of biogas** that can be converted into electricity, heating / cooling or used as a raw material in industry
b) **digestate that can be processed into biofertilizers**. These contain all the important chemical elements and microorganisms that increase the biodiversity of the soil and can act as biological control. Organic carbon structures in biofertilizers are important energy sources for soil organisms and contribute to carbon storage.

The production of locally produced biofertilizers can phase out most mineral fertilizers and other chemicals, reduce the need for energy and transport in the world, reduce pollution caused by the production of mineral fertilizers and chemicals. The risk of acid rain, eutrophication and dead seabeds will be significantly reduced. In local communities, the degree of self-sufficiency and cohesion will increase.
There will certainly be comments regarding drug residues. Today there is no control over how nature is affected. In projects with the proposed SBRS concept, drug residues and their inactivation can be followed up in the bioreactor and later in the soil. The use of activators containing various enzymes can, during the biological transformation in the bioreactor,

accelerate the inactivation of drug residues. SBRS concept is presented on http://biotransform.eu/wp-content/uploads/2022/05/From-Photosynthesis-to-Photosynthesis-SBRS-concept-RS-BS.pdf.

As food and toilet waste will go directly to bioreactors, contamination of water with drug residues and several different chemicals is excluded. This minimizes the risk of fish and other organisms that humans use as food becoming contaminated.

Foil of biomaterials that will be used to collect and package food and toilet waste requires fragmentation during pre-treatment in biogas plants to increase the availability of the element carbon for microorganisms that handle the microbial transformation. Of course, in the digestate and in biofertilizer, small pieces of foil remain which continue to be further digested by known - and still unknown - microorganisms in the soil.

For manufacturers of bioplastics, the challenge will be to produce the most adapted foils of biomaterial for the purpose. The impact on soil structure and on the microbial turnover in the soil must be monitored by researchers in soil science.

Important research in the field and generally improvements of biogas plants - that today mostly use water-borne unsustainable methods - are neglected. The microbial optimum is about 30% dry matter and therefore biogas plants that use about 6% dry matter in bioreactors are economically unsustainable.

Investments are now required in innovation projects where food and toilet waste constitute the necessary "guaranteed long-term supply of input materials" and are mixed with Renewable Organic Material that today go to unsustainable combustion, thermal gasification, pyrolysis, or loss-making and polluting composting.

Bioenergy is the sun's radiant energy converted during photosynthesis and stored in the plants' biomass using at least 16 chemical elements called essentials that form carbohydrates, proteins, and fats. **In the EU, we have as much bioenergy available per year as all plants have captured and stored.**

The bioenergy of plants is converted by animals, microorganisms and by humans into heat, movement and some is stored in the cells of all organisms. Sometimes a simplified expression is used that the plants give us food, feed, fibre, and fuel, but in fact bioenergy is available as fuel in food, feed, fibre and in their residual products and waste. **How much bioenergy is used and how much is wasted?**

A new Circular Economy Action Plan For a cleaner and more competitive Europe

COM/2020/98 final **There is only one planet Earth**…..
… towards **keeping its resource consumption within planetary boundaries**….

REPowerEU: affordable, secure and sustainable energy for Europe
EU'S NEW ENERGY PLAN 'REPowerEU' SHOULD NOT BECOME A SMOKESCREEN FOR LOCK-IN TO FOSSIL FUELS - CAN Europe