Fermentation of waste from argriculture and food industry is a source of renewable energy in a form of biogas and digestate with valuable fertilizing properties. Digestate can be stored or further fermented before agricultural use. When livestock manure is used as a co-substrate for fermentation, high concentrations of nitrogen in the digestate can limit its use as a fertilizer.

Many biogas plants separate digestate into solid and liquid fractions. The solid fraction occupies a smaller volume, has a less offensive odor and can be used as a fertilizer after aerobic stabilization. The nitrogen-rich liquid fraction can be treated using physico-chemical or biological processes. Biological methods are an attractive alternative, but their use has been limited by the inability of the biomass to tolerate high nitrogen loads. Our previous results show that aerobic granular sludge technology is an alternative to conventional biological methods for treating high-nitrogen wastewater. Aerobic granules are spherical microbial consortia self-immobilized in extracellular polymer matrix; this matrix increases the resistance of microorganisms to high pollutant loadings. Aerobic granular sludge reactors are operated at biomass concentrations up to 3-4 times higher than systems with activated sludge, resulting in more efficient biological treatment and in lower operational costs.

Thus, the aim of the proposed project is to test the usefulness of aerobic granular sludge technology for removal of nitrogen compounds from the liquid fraction of digestate. The research will be conducted in two stages. The first stage will be carried out in three granular sludge reactors operated at different cycle lengths and fed a mixture of the liquid fraction of digestate and municipal wastewater. The effluent from the reactor that removes ammonium the fastest will then be used in the second stage. In this second stage, denitrification will be performed to remove the oxidized forms of nitrogen, so that the effluent can then be recycled into the fermentation reactor or used as fertilizer. In addition, there will be an investigation into the morphological and microbial structure of aerobic granules in reactors operated at high organics and nitrogen loads.

This project will increase knowledge of the technological and microbial bases of aerobic granulation and help to resolve problems with the management of digestate from agricultural biogas plants.