Description for the general public

The objective of the project is better understanding microbial dehalogenation processes and relations between microbial community and appointed environment components responsible for difficulties with biotransformation of halogenated organic compounds. Furthermore the project will help to increase the efficiency of dehalogenation and finally propose the method of organohalogens biotransformation by microbial metabolites application.

Halogenated organic compounds pose widely distributed in the environment, toxic, carcinogenic chemicals. Their impact to the environment is strongly negative due to their physicochemical features, that they owe to halogen substituents: fluorine, chlorine, bromine and iodine, providing to reducing water and increasing lipid solubility, that yield to their accumulation in fatty tissue. Moreover the halogenated compounds are persistent, all that makes them resistant to degradation, what causing their accumulation in the environment. Interesting is fact that this compounds have been present since the appearance of life on earth and all data show that there was no problem with organohalogens transformation before. So why do they implicate so many difficulties to the environment nowadays? The problem is with xenobiotic (anthropogenic), not natural organohalides, that production increase substantially in last decades. To example annual production of vinyl chloride is estimated at $27 \cdot 10^6$ t and chloroform 440 kt (WHO 1987, 1999). The main players in biogeochemical cycle of halogens are microorganisms and they have difficulties with transformation and degradation of the anthropogenic halogens. What is interesting, microbes do not have any troubles with dehalogenation (cleavage of carbon-halogen bond using the proper enzymes) of natural halogenated organic chemicals.

In this project I will try to survey the microbial transformation of natural and anthropogenic organic compounds to overcome difficulties with transformation of xenobiotic organohalides and answer the question- what is the difference in microbial dehalogenation of anthropogenic and natural organohalides? To realize the objectives will be performed screening of genes and proteins in selected environments, where are present natural and anthropogenic organohalogens to consider the dehalogenation potential of native microorganisms. Microbes will be isolated and selected to transformation of organohalides' simulations. The dehalogenation degree will be controlled by a gas chromatograph equipped with a Flame Ionization Detector (GC-FID). During the simulations of dehalogenation processes will be studied enzymes produced by microbes.

Results from simulations, metagenomic and metaproteomic analyzes will help to overcome difficulties in biotransformation and will help to increase effectiveness of anthropogenic organohalogens, will indicate enzymes and genes involved in dehalogenation process of particular halogenated compound and will create new strategy of utilized isolated metabolites to organohalogens transformation. Analyzes of metabolic pathways will show the dependencies between dehalogenation and different factors like electron donors, source of carbon and energy or presence of electron shuttles. The project was written in order to broaden the current state of knowledge in the field of environmental microbiology and environmental biotechnology, and will deliver the information and a better understanding of microbial dehalogenation processes which will lead to faster and more efficient transformation of toxic, anthropogenic halogenated hydrocarbons.