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BOOK of ABSTRACTS

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Ohrid, Republic of Macedonia

Miroslav M. Ivanov
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Сојуз на хемичарите и технолозите на Македонија

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PL 006

BIOREMEDIATION: GREEN CHEMISTRY AT WORK

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Bioremediation (in the strict sense of the meaning) is the application of microorganisms (most often bacteria and fungi)–"biological agents" in the degradation and immobilization (toxic metals hydroxides or sulphides) of practically all pollutants of the environment, including POPs, and hexachlorocyclohexans-HCHs as one of high resistant, while products that are not hazardous for humans and the environment are obtained. This applies both to polluted ecospheres and stored and controlled pollutants. Each process of bioremediation during which microorganisms under aerobic conditions (anaerobic processes are more unfavourable) use a pollutant as nutrient or energy substrate, resulting in its mineralization as shown in the general equation:

$$C_cH_hO_oN_nP_pS_sCl_{cl} \rightarrow cCO2 + h/2\ H_2O + nNH_4^+ + pHPO_4^{2-} + sSO_4^{2-} + clCl^- + \text{Biomass} + \text{Energy}$$

"Green technology" is a colloquial expression for the application of principles of green chemistry and its implementation through green engineering, with the inclusions of principles of this contemporary branch of (bio)chemical engineering, thus making a contribution to sustainable development and making the subject of "sustainable chemistry" one that is being increasingly spoken of in the past several years at most as a fundamental ideal of acceptable and desirable "zero waste" technologies that are being more closely approached by the **b**est **a**vailable **t**echnologies (BAT).

Green chemistry/green engineering is basically a set of principles (12+12) for the reduction of key elements that are the pillars of every technology (energy, raw materials and other accessory materials, equipment, risks and hazards, volatile organic compounds, waste, environmental impacts and the price).

Bioremediation is practically true "green technology", because the contaminant is disintegrated up to the level of carbon dioxide and inorganic mineral components, while biomass that increases fertility of the substrate is obtained, *i.e.* it becomes humificated regardless of whether it is a natural or artificial soil substrate-man made soil. Carbon dioxide that is released during the process of respiration of microorganisms is of biological origin and it is practically generated without being warmed up. The application of bioremediation procedures often occurs at the biodegradable waste generation site, by which one more of the green principles is being fulfilled, and it has a positive effect on the environment and bears no risks for workers, and therefore, with the utilization of biodegradable natural and most often waste auxiliary substrates and inorganic inert materials, with the minimum power consumption and acceptable prices versus effectiveness and efficacy.

Keywords: bioremediation, green chemistry, microorganisms

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