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Wastewater treatment technology at high-potential sewage treatment plants with antibiotics, pesticides or other biologically active substances

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Abstract:

The invention consists in the development of a wastewater treatment technology from urban or hospital treatment plants with high risk of antibiotic contamination and implicitly with high risk of generating antibiotic resistance genes for antibiotics. The invention consists in the use of natural or synthetic zeolites or more complex mixtures containing additional and absorbent components such as activated carbon, mesoporous silica or active components such as photocatalytic nanoparticles: TiO_2 or ZnO for the destruction of adsorbed antibiotics. The proposed technology assumes that in the final stage of treatment, the resulting water is additionally passed through a tank loaded with the aforementioned adsorbent system and thus the antibiotics are adsorbed without being discharged into the wild. In this way, the microorganisms in the emissary are not exposed to antibiotics, at a sub-therapeutic level (which can generate antibiotic resistance). Given the alarming level of resistance of microorganisms to antibiotics, this technology is especially necessary in the case of treatment plants of antibiotic factories (and not only), hospitals (and especially infectious plants), livestock farms, etc.

Experimental:

Mesoporous silica has proved good adsorption capacity for a wide range of toxic agents, including antibiotics. Starting with these premises, pure porous materials can be used to adsorb these toxic agents or, they can be loaded with photo-active agents, such as ZnO or TiO_2 and in this case the adsorbed toxic agents are destroyed continuously.

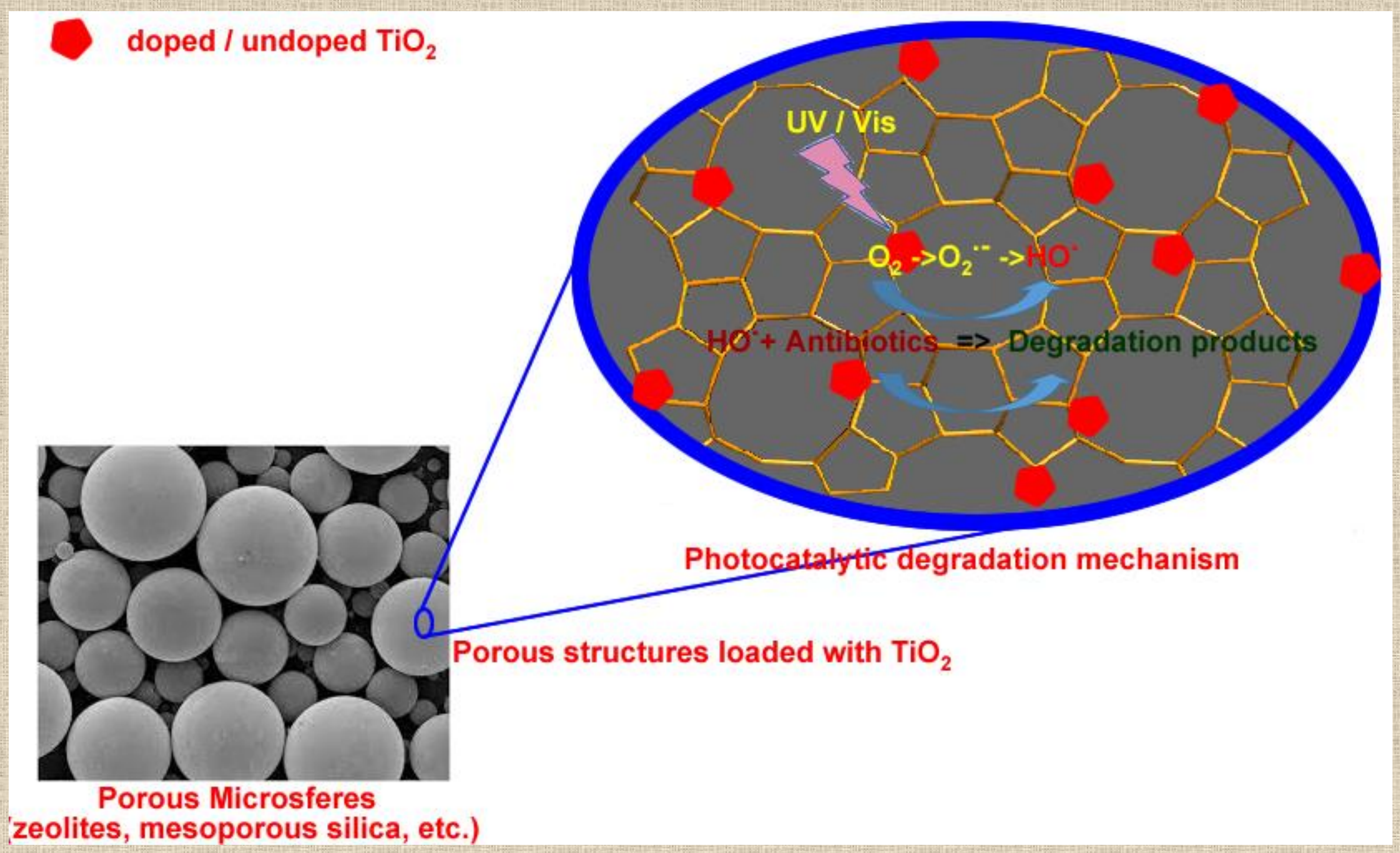

Figure 1. Adsorption and photo-degradation mechanism of antibiotics

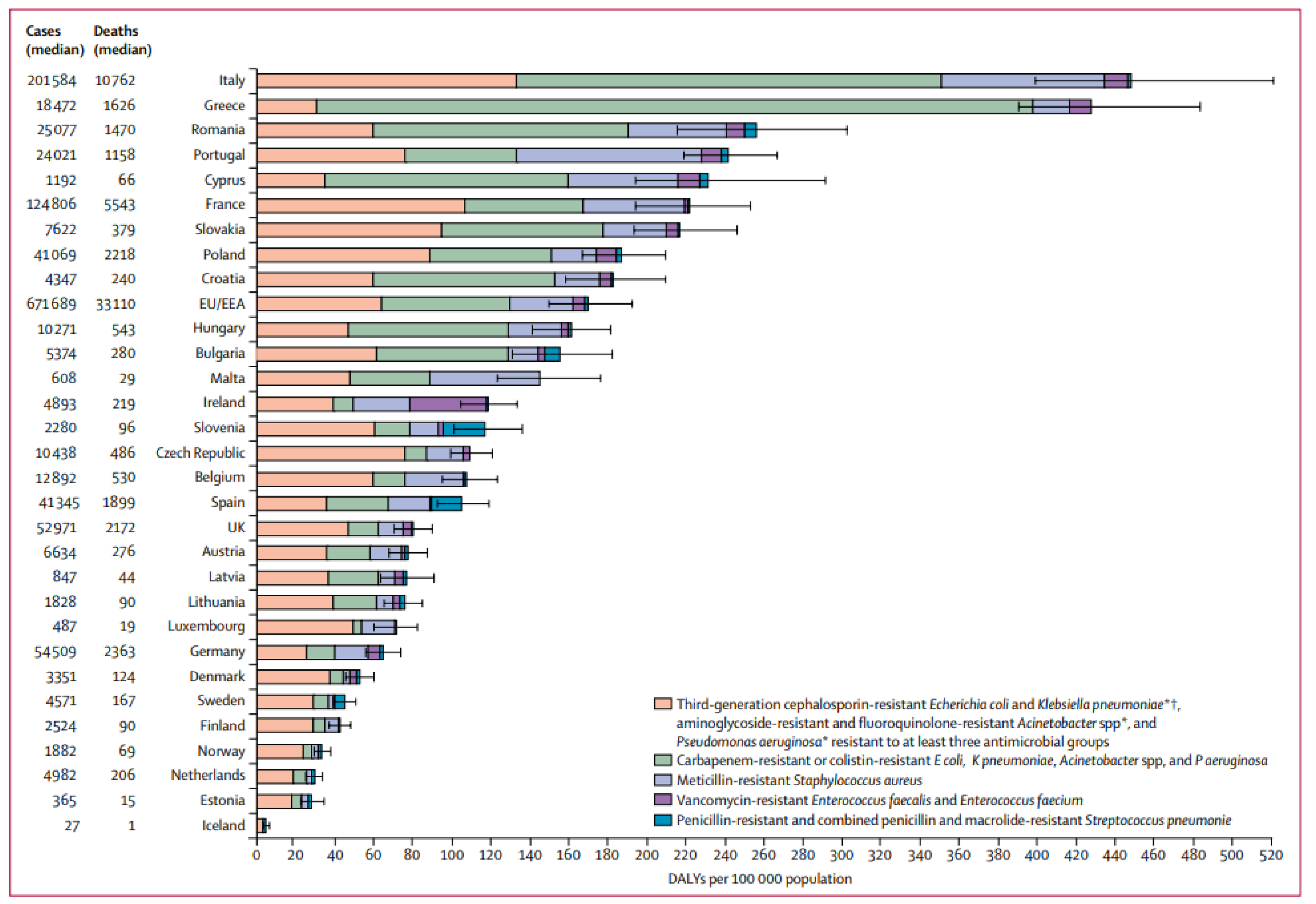

Figure 2. Statistics related to Antibiotic Resistance

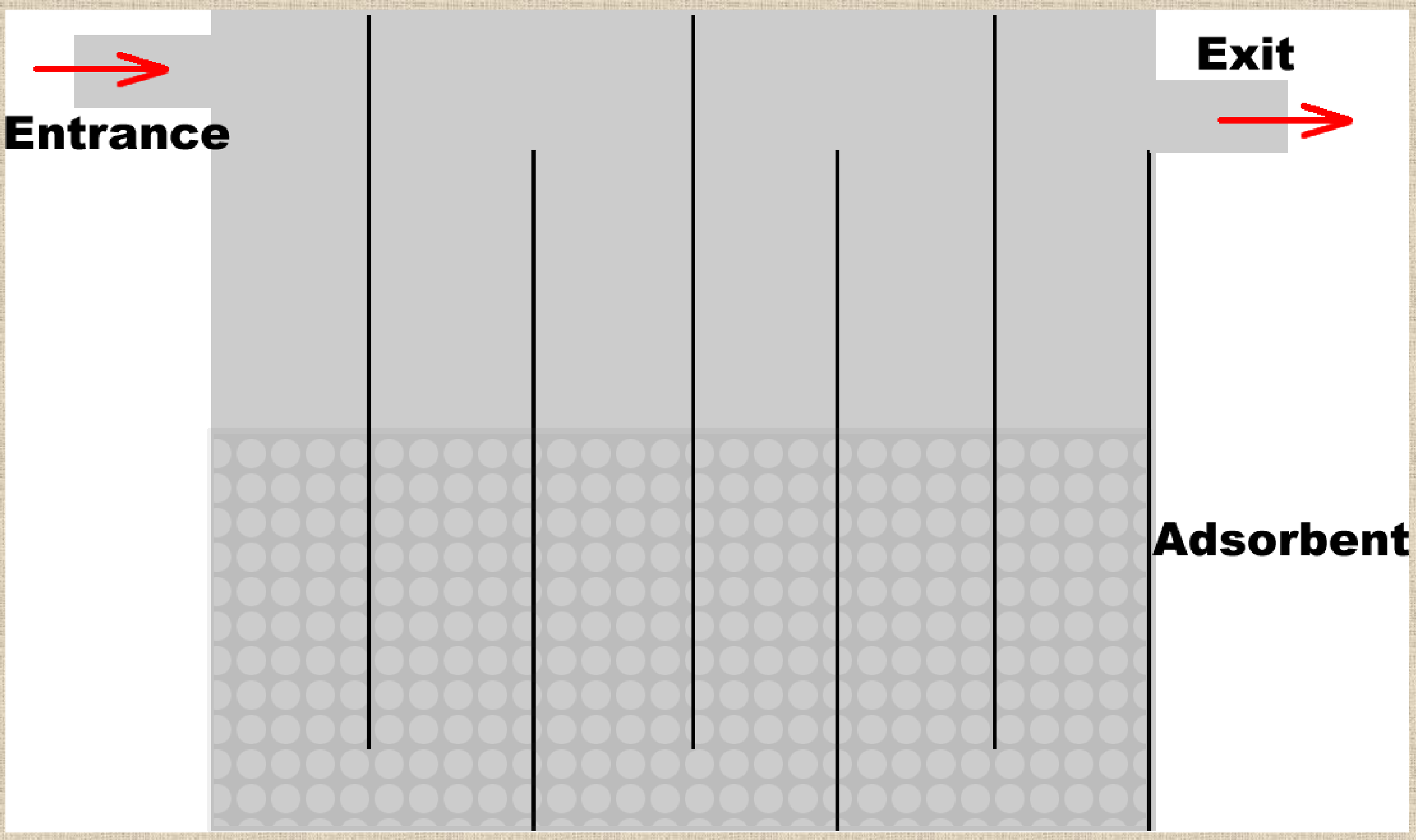

Figure 3. Adsorption tank for antibiotics, residues and other toxic agents

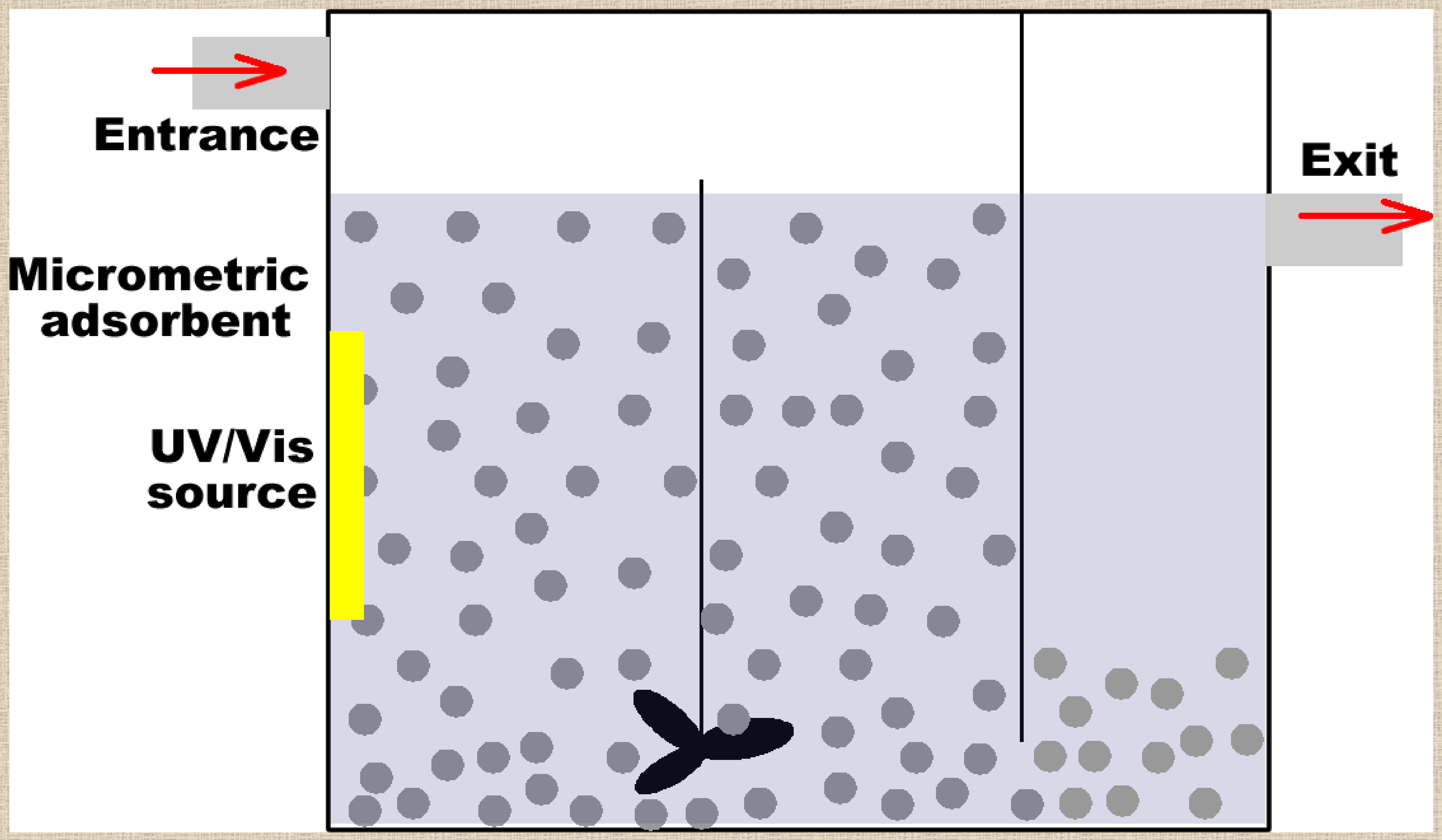

Figure 4. Adsorption tank with simultaneous agitation and degradation of antibiotics, residues and other toxic agents

Conclusions:

The proposed technology can be easily adapted for the current treatment procedure, by extending the wastewater treatment plant with an additional tank (according to Fig 3 or 4) and loaded with pure adsorbent or adsorbent loaded with photo-active nanoparticles (ZnO or TiO_2). The presence of the photoactive agents will additionally assure the degradation (under UV/Vis radiation) of the toxic agents (antibiotics, pesticides, etc.) avoiding the need to monitor adsorbent loading and once the maximum adsorption was reached to replace with new adsorbent. TiO_2 and ZnO can be modified by doping with adequate elements and became active in visible light. As a consequence of this additional step, the antibiotics are extracted from the wastewater and thus, the existent bacterial cells are not exposed and the antibiotic resistance is not generated prior to the contact of these cells with the human/animal body.

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