support of sustainable development

– ecologicaly and economicaly beneficial technologies for the removal of emerging micropolutants from wastewater effluents

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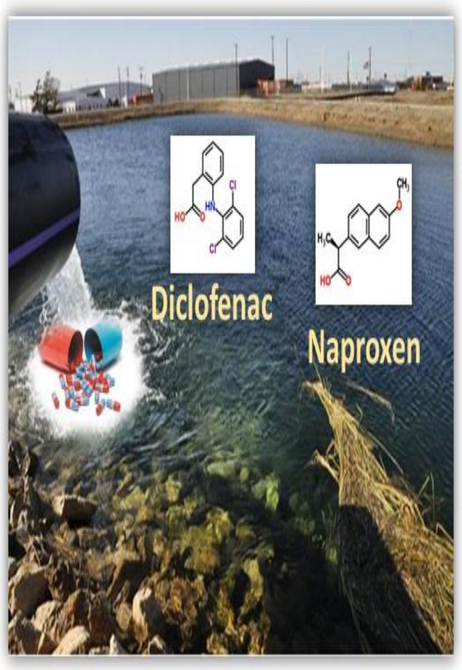
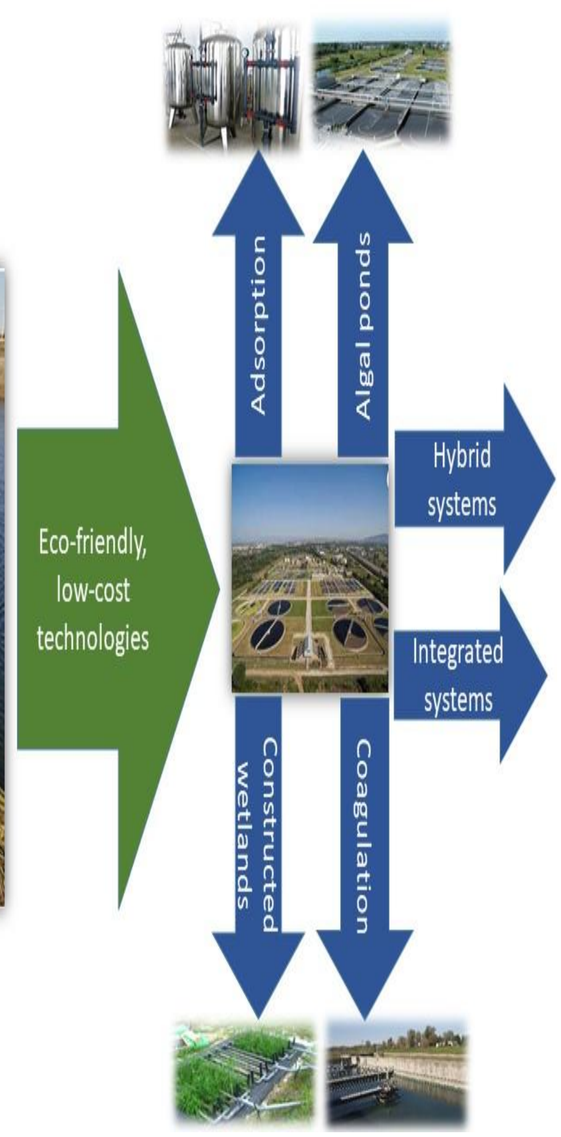
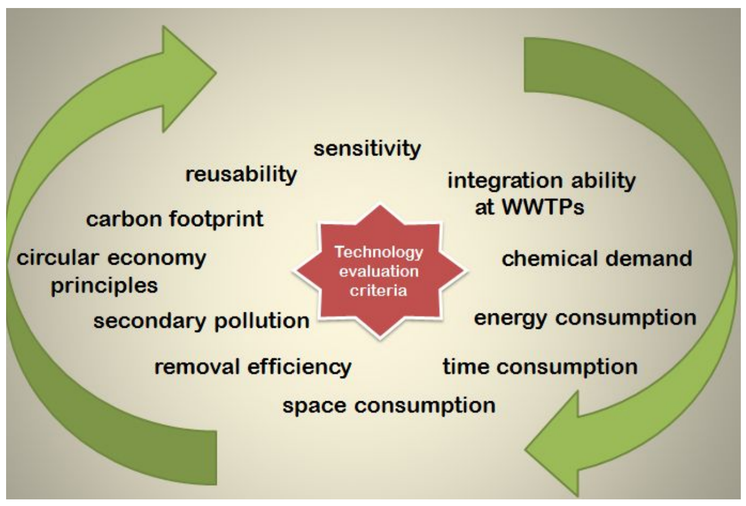
To ensure sustainable wastewater management of interest for both developed and developing countries, priority should be given to the transition from the end-of-pipe to more proactive wastewater pollution prevention. Cost-beneficial, green technologies could pose a promising alternative solution for the removal of emerging micropollutants.

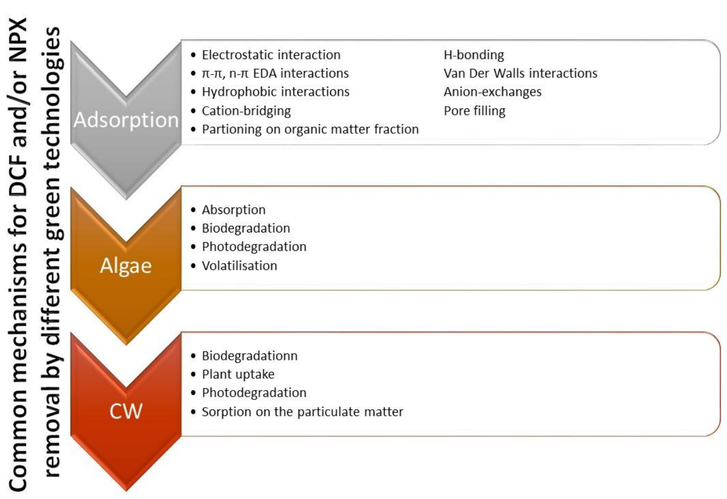
Diclofenac (DCF) and naproxen (NPX) are pharmaceutically active compounds that belong to the group of non-steroidal antiinflammatory drugs (NSAIDs), ubiquiteously present in wastewater effluents, which represent their main source in surfice and groundwaters. An ever-growing consumption, pseudo-persistance and proved toxic effects to biota even at low concentrations ranging from several ng to several μg, makes these pain-killers part of many monitoring and priority lists including NORMAN, REACH, EU WFD Watch list (until 2020) and different national lists of priority substances.

Based on the 11 criteria following technologies were selected and reviewed as low-cost, eco-friendly, and widely affordable technologies for the removal of DCF and NPX from wastewater effluents: adsorption, algae-based systems, constructed wetlands, and coagulation. Some of their combinations/hybrids were also reviewed. With the exeption of coagulation, all technologies achieved high removal rates towards target NSAIDs under optimal conditions. Coagulation was found to be more effective as a pre-treatment where mainly suspended and colloidal particles were removed alowing easier approach of another technology to selectively remove target micropollutants. Algal ponds and constructed wetlands showed advantages of using plants as purification mediums, but they required large space for installation and usually longer hydraulic retention time. On the other hand adsorption was evaluated as very fast and very efficient process which can satisfy principles of circular economy by utilisation of waste materials for the production of low-cost adsorbents. For instance, agro-industrial by-products were found as an attractive and abundant precursors for adsorbent production. Chitosan, clay-based adsorbents and biochars were also used by many researchers for the same purpose. One of the most important adsorbent properties that influence its eco-friendliness and cost is regeneration ability, but it was not yet thoroughly investigated for all adsorbent types.



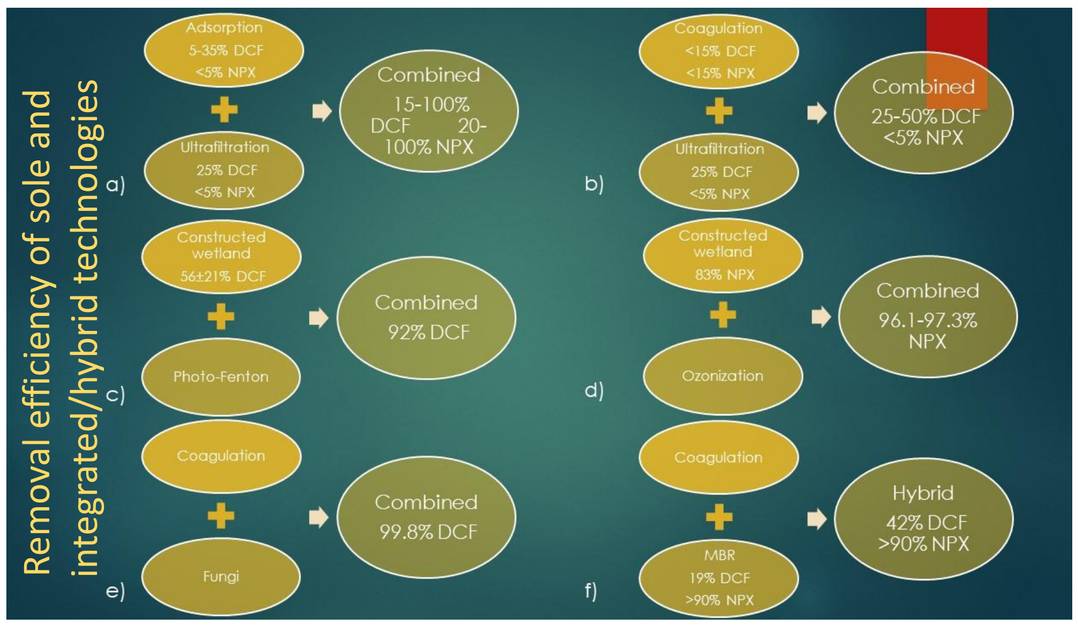






In order to overcome known, existing problems of each technology, integrated/hybrid technologies were applied. Combination of two or more technologies was proved to significantly (up to 70%) enhance removal of DCF and NPX in comparison to the effectiveness of the single technology. Constructed wetlands are one of the most extensively combined technologies.

Although extensive research has been done so far, all mentioned technologies should be more investigated in real and environmentally relevant conditions before their actual application in the real systems.



This research has been supported by Innovation Fund, Republic of Serbia, ID 5156 through project Proof of Concept, by the Ministry of Education, Science and Technological Development through the project no. 451-03-68/2020-14/200156: "Innovative scientific and artistic research from the FTS (activity) domain" and mobility funding which facilitated study at Environmental Research Institute in Scotland provided through ERASMUS + Higher Education International Credit Mobility – Project 2018-1_UK01-KA107-047241 between North Highland College, Thurso and Faculty of Technical Sciences, University of Novi Sad, Serbia.

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Funded by the DAAD from funds of the Federal Foreign Office:
DAAD Deutscher Akademischer Austauschdienst German Academic Exchange Service
Federal Foreign Office