**Use of commercial and agricultural waste as bio-adsorbents for removal of heavy metals**

With the industrial boom and advancement in industries large amount of waste is released of different nature. Handling waste having diverse nature is a big problem. One of the recent problem due to this is release of heavy metals. Heavy metals are extremely dangerous and many of them are carcinogenic as well. Heavy metals pollution is increasing day by day and is posing a great threat to lives of all living organisms. Heavy metals are essential for proper growth and functioning of living organisms but in minute quantities. If their concentration increases more than permissible limit, they pose a great threat. No matter they are essential nutrients. Heavy metals are great nuisance as well because they can’t be biodegraded in to less toxic forms. Several health problems are caused by heavy metals. Like oxides of iron and zinc cause vomiting and gastric problems. Ni, Cr, Cd and Cu are responsible for heart diseases, leukemia, cancer and Co and Mg cause anemia and hypertension. Exposure to excessive metals in air can lead to asthma, respiratory problems and cardiovascular problems (Shakir et al., 2017).

Treatment of effluents before releasing them is extremely necessary, otherwise it will cause excessive deterioration of ecosystem. For this scientist have devised different techniques for removal of heavy metals. Conventional techniques include various physico-chemical techniques. Physical techniques are mechanical screening, hydrodynamic classification, gravity concentration, flotation, magnetic separation, electrostatic separation and attrition scrubbing.

The chemical techniques are chemical precipitation, flotation, adsorption, ion exchange, coagulation and flocculation, electrodialysis and electrochemical deposition. These techniques were used conventionally, but they had some drawbacks. Their limitations include production of large amount of sludge, less efficiency, high operation cost and sensitive operation conditions. Treating waste is done with a concept of reducing amount of waste but these techniques produce a large amount of waste at the end. For an industrialist the main goal is generation of revenue not spending money on treating waste. That’s why high operation cost techniques are not favoured. Due to these drawbacks their use become limited (Gunatilake, 2015).

As a result, scientists came up with a new idea. They introduced adsorption technique. For adsorption process different materials are used. Materials possessing high surface area, porous structure, high ion exchange capacity and presence in large amount in nature make it a suitable material for adsorption purposes (Renu; Madhu Agarwal K. Singh, 2016). Some of the adsorbents that are used commercially are graphene, activated carbon and carbon nanotubes. Graphene is used as this nanomaterial is efficient in removal of heavy metals because of high surface area, enhanced active sites and functional groups that facilitate the removal. It is a carbon-based nanomaterial with high chemical stability. It can be oxidized to add hydrophilic groups for removal of heavy metals. Another adsorbent is use of activated carbon. It was first made by wood materials. It is a good adsorbent because of high porosity and high internal surface area. It can be made from any material having high carbon content. But afterwards its use decreased because of high cost. Carbon nanotubes are used as well for adsorption purposes. They are efficient adsorbent because of chemical stability, excellent mechanical and chemical properties, well developed mesopores and large surface area. These adsorbents are expensive so their use become limited (Gunatilake, 2015).

To overcome this problem scientists came up with a new idea to deal with problem of heavy metals. They used agricultural waste as bioadsorbent for removal of heavy metals from wastewater. They are preferred because of low cost, high renewability, high affinity with metals and easy regeneration. It is a new technique to handle waste and reduce its quantity in an eco-friendly way (Nguyen et al., 2013). Plant and agricultural waste are used for making adsorbents for removal of heavy metals from wastewater. Materials use dare rice husks, sugarcane bagasse, sawdust, spent grain, wheat bran, fruit and vegetable waste, plant fibers, tree bark, coconut choir, tea and coffee residue are used (Wan Ngah & Hanafiah, 2008) (Y. Orhan; H. Büyükgüngör, n.d.). Agricultural wastes are modified as well to increase their efficiency. Rice husk, wheat bran, fruit peels, peanut shells, okra waste, egg shells, straw, coffee, apple pomace and olive stones are use for removal of heavy metals from wastewater (Grozdanov et al., 2018).