INTRODUCTION

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Water is the most essential commodity for human consumption and it is one of the renewable resources which must be prevented from deterioration in quality (Beebi *et al.*, 2009). Due to increasing industrialization, urbanization and technological developments, the water bodies are contaminated with industrial effluents, sewage, domestic waste, agricultural and land drainage (Melgar *et al.*, 2007).

Water pollution by industrial effluents has become a great concern in recent years. The effluent has the capability to pollute the water quality of receiving water bodies (Brombach *et al.*, 2005). Industrial waste water contains many kinds of heavy metals, organic compounds, nitrates, nitrites, sulphates, chlorides, oil and grease and other compounds (Patil and Hande, 2004).

Heavy metal contamination of waste water is an environmental enigma and removal of these toxic and persistent contaminants is highly imperative as they get biomagnified along the trophic level (Ahluwalia and Goyal, 2003). Today indiscriminate and uncontrolled discharge of metal contaminated industrial effluents at higher concentrations into the environment has become an issue of major concern to environmentalists. Due to the lack of any treatment and improper disposal of effluents on land and natural streams, there exists a potential hazard to plants, animals, human beings and soil (Anderson *et al.*, 2004).

There has been a phenomenal increase in the number of plating and metal finishing industries in recent years. Wide range of chemicals used in the electroplating and metal coating jobs contribute greater problems to the environment because of their toxic and corrosive nature and also pose health hazards (Agarwal *et al.*, 2006).

Electroplating is one of the important processes involved in surface finishing and metal deposition for better life of articles and for decoration. During the rinsing of the electroplated articles and the washing of electroplating tanks, considerable amount of the metal ions find their way into the effluent. The process involves metals such as cadmium, chromium, nickel, zinc and their compounds (Murugaiyan and Kanmani, 2009).

Nickel is one of the most important essential elements and it occurs most abundantly in the earth's crust. Global input of nickel into the human environment is approximately 150,000 metric tonnes per year from natural sources and 180,000 metric tonnes per year from anthropogenic sources (Hostynek and Maibach, 2002). It is used in the manufacturing processes of stainless steel, ore refining, pigments, batteries, petroleum, food processing, plumbing, alloys and in electroplating (Sharma and Agarwal, 2005).

Though nickel is considered to be a prime metal needed for the healthy growth of plants, animals and soil microbes, its excess is known to cause liver, kidney, spleen and brain damage, vesicular eizema, lung and nasal cancer and tissue damage in humans (Reddy *et al.*, 2007). It is also reported by Akhtar *et al.* (2004) that the waste water discharged from electroplating, electronics and metal cleaning industries often contained high concentration of nickel ions and caused various types of acute and chronic disorders. Fordsmand (1997) reported that the nickel toxicity in plants caused patchy discolorations, premature senescence, yellowing of old leaves and growth reduction, thus affecting the photosynthetic functions of higher plants. The effluents containing nickel was also reported to cause stress in aquatic animals and disturb their metabolic and physiological activities. This heavy metal when enters into the soil might affect the decomposition of organic matter and reduce the soil fertility (Einax and Soldt, 1998).

In recent years, the extent of nickel pollution has been recognized evoking the attention of many researchers on its removal from the environment through efficient means (Mclaren and Clucas, 2001).

Unlike organic compounds, the heavy metals cannot be degraded and their remediation is the need of the hour which is a challenging problem for the environmentalists. Thus the removal and recovery of heavy metals from waste water is important in the protection of the environment and human health (Ahluwalia and Goyal, 2007).

Various physicochemical processes such as precipitation, sludge separation, oxidation, reduction, ion exchange, reverse osmosis, electrochemical treatment and evaporation were used in the removal of metals from aqueous solution before they are disposed off. The major disadvantage with these conventional treatment techniques is the production of sludge. These processes are expensive and not ecofriendly which in due course may change the aquatic environment into a solid dumping area (Wang and Chen, 2006).

Bioremediation is an emerging technology which is gaining more attention among the environmentalists, for the removal of heavy metals using microorganisms. Further, it is cost effective and economical to the environment (Rajvaidya and Kumar, 2003).

The metal uptake by microbial biomass takes place by two basic processes. The first is through simple ion exchange process and the second involves the formation of complexes (coordinate compounds) with the functional groups of the cell wall (Bishnoi *et al.,* 2005).

Sequestration and immobilisation of heavy metals, especially in the effluents can be accomplished through biosorption, a passive process of metal uptake, using microbial biomass. Biosorption is essentially a non-directed physicochemical reaction between dissolved metal species and charged cellular components, which involves sorption of metals to living or dead cells. Also, insoluble metal species can be physically entrapped in the microbially produced extracellular matrix or precipitated in bacterial or fungal exudates (Calfa and Torem, 2008). Microorganisms such as fungi, bacteria and algae are the commonly used agents in biosorption of toxic metals from the effluents (Mungasavalli *et al.,* 2007).

In recent years, the use of biologically treated effluent has created awareness among the community for effective waste water management and utilization. In Kolkata, a trend has been practiced in recycling the waste water through biological process and was used for garbage based vegetable farming, paddy fields and fish culture (Nandeesha, 2002).

With the development of science and technology in the recent past, the waste water is regarded as a wealth and instead of its disposal as such it can be recycled for the benefit of mankind in fish farming and agriculture (Suresh, 2003).

Based on the ecotoxicological effect of raw nickel electroplating effluent the present investigation has been undertaken to study the effect of microbially treated effluent on the growth and biochemical constituents of green gram and cat fish.

Therefore, the present study is carried out with the following objectives:

- To isolate and characterise the metal tolerant bacteria and fungi from the nickel electroplating effluent contaminated soil sample.
- To identify the optimal experimental conditions for the maximum and efficient removal of nickel using selected bacterial and fungal isolates.
- To assess the physicochemical characteristics of the raw and biologically treated nickel electroplating effluent.
- To study the impact of nickel electroplating effluent on the biometric, biochemical characteristics of green gram plants and on soil quality.
- To assess the impact of nickel electroplating effluent on the growth, biochemical constituents and nickel accumulation in selected organs of the study fish.
- To observe the histological changes in the selected organs of the fishes grown in different treatments.