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Pollution of water has been over the years variously defined. Biologists refer it as "reduction in diversity of aquatic life and eventually destroying the balance of life in the stream" (Patrick, 1953) or "adverse change in plant and animal communities" (Hawkes, 1962).

Not all wastes are pollutants in themselves, but all have the capacities to be so. According to the definition given by Werner, "a substance is normally considered to be a pollutant if it adversely alters the environment by changing the growth rate of a species, interferes with the food chain, is toxic, or interferes with health, comfort, amenities or property values of people". A polluting substance can be a solid, semi-solid, liquid, gas or sub-molecular particle. Pollution is the result of the action or presence of the pollutant in a part of the environment where it is considered to have deleterious effects.

Water is used for various purposes in large quantities by the industries. The waterborne wastes are inevitable result of nearly all manufacturing industries. Most of it is discharged from the plant premises itself. Such discharges contain small amount of all materials used in the manufacture of a product by the industry like raw materials, manufactured products, intermediate products, by-products and other substances which are unavoidably lost in the processing. Heavy metals like chromium, mercury, zinc and cadmium may be toxic and inhibit normal metabolic processes of the biota when present in high concentrations (Becker et al., 1985).
Water may be polluted either by the introduction of substances, which are foreign to the natural environment or by the occurrence of abnormal levels of natural factors. Since water is an aquatic environment and also a natural resource of major importance to man, treatment processes in pollution prevention must therefore involve both the protection of water as a resource and the protection of the aquatic environment generally. The total amount of water available for use is limited and water shortages are becoming more common. Wastewater can be regarded as an additional water resource and its planned reuse for purposes other than drinking can result in a great saving of clean water supplies (WHO, 1973). It was during 1972 Stockholm Conference that the degradation of environment due to rapid industrialisation and other developmental activities started concerning the environmentalist.

The industrial wastewaters contain many xenobiotics (Chemically synthesised substances having configurations unknown in natural substances), which are poorly degradable. These include pesticides, halogenated aliphatics, aromatics, nitroaromatics, chloroaeromatics, polychlorinated biphenyls, phthalate esters, etc. Because of their continuous persistence, they resist biodegradation and assert toxic effect by moving up the food chain great quantity of natural organic compounds like proteins carbohydrate lipids, nucleic acids are metabolised and recycled by microbes and therefore do not pose any threat to the ecosystem. The majority of organic pollutants originate from industries involved in food processing, tannery, gelatin manufacturing, pulp and paper milling, textile processing, organic chemicals, synthetic products etc. The industries expected to discharge high nitrogen containing effluents include
meat packing, milk processing, refineries, fertilizer manufacturing, synthetic fibre processing. The organic waste not only cause serious pollution problems in receiving waters but may also threat the human health.

The organic wastewater amenable to biological degradation and occur naturally as well as by large number of industries too. The organic pollutants originating from the industries may be involved in petroleum refining, organic chemicals and synthetic products as well as in coal conversion, steel milling, food processing and tannery (Higgins and Burns, 1975; Rawling and Bamfield, 1979; Derenzo, 1980; Luthy, 1981 and Wise and Fahrenthold, 1981). The metabolism of the organic matter by the natural organisms contained in the receiving water, causes oxygen depletion and elimination of normal aquatic flora and fauna (Apoteker and Thevenot, 1983). Inorganic chemicals do not effect the oxygen levels directly except for a few oxygen carriers like nitrates and are therefore not of prime concern (Taylor, 1965). Effluent discharges increase the concentration of plant nutrients, such as nitrogen and phosphorous, in water and enhance the producer component of the eco-system thus creating an imbalance known as eutrophication. Ammonia is directly toxic to aquatic life but its oxidised products can cause nutrient enrichment, leading to eutrophication (Atlas and Bartha, 1981; Wheatley, 1984). The discharge of ammonium into the surface water results in nitrification and thus results in depletion of dissolved oxygen (Verstraete and Vaerenbergh, 1986).

The microbial world is characterised by an incredible metabolism and physiological versatility that permits microorganisms to inhabit hostile ecological niches and to exploit
compounds unpalatable to higher organisms. This metabolic versatility has lead to the notion of microbial infallibility, their ability to degrade and to grow at the expense of any organic material and is also the basis of the recycling of recalcitrant organic matter in the biosphere. It is therefore natural and logical that this enormous metabolic potential be harnessed to develop effective biotechnological processes for the elimination of wastes. (Timmis et al. 1994)

The adsorption capacity of microbial sludge and slimes used in waste treatment enables a range of materials to be removed from wastewaters other than organic nutrients. For example, heavy metals found in sewages sludge include Zn, Cu, Pb, and Ni in significant quantities and traces of Mo, Cd, Se and Hg. (Institute of Water Pollution Control, 1976). The metal removal efficiency varies with different strains of bacteria- one strain accumulated 34% Cu or 25% CO, based on the dry weight of organism (Friedman and Dugan, 1967). A number of bacteria can become visibly encrusted with maganic oxides, and *Hyphomicrobiurn* is involved in deposition of Mg and also Fe in freshwater pipelines (Kelly, Norris and Brierley, 1979). *Gallionella* uses Fe as a nutrient and grows long stalks containing iron compounds, and various metals have been concentrated from solution by masses of *Sphaerotilus* the principal organism of "sewage fungus and the accumulation of large quantities of iron and other metals is usually associated with these slime forming or "iron bacteria".

An array of biological processes for the removal of phosphoruous and nitrogen are practised. Nitrogen is converted to nitrate by biological nitrification, which requires prolonged and
vigorouse aeration. It takes place in two steps as a result of the activity of autotrophic bacteria of the genera *Nitrosomonas*, which converts ammonia to nitrate, and *Nitrobacter*, which converts nitrite to nitrate (Curtis *et al.*, 1975; Atlas and Bartha, 1981; Verstraete and Vaerenbergh, 1986). Important bacteria involved in denitrification process belong to genera *Pseudomonas*, *Alcaligenes*, *Acinetobacter*, *Hyphomicrobium* and *Thiobacillus* (Focht and Verstraete, 1977). Several workers have found high number of these bacteria in phosphate removing sludge (Fuhs and Chen, 1975; Dienena *et al.*, 1980; Buchan, 1981). Phosphate uptake has been reported for other microorganisms like *Escherichia coli* (Medvecsky and Rosenberg, 1971) and *Azotobacter vinelandii* (Tsai *et al.*, 1979).

The generic microorganisms occur naturally and are indigenous to the waste. The use of generic microorganisms is usually most effective when they can readily change the molecular structure of the target materials under physical and chemical conditions optimum for their activity (Shuckrow *et al.*, 1981). The enriched microorganisms are cultured to degrade a specific waste or waste mixture and are useful when generic microorganisms are not effective or remain in low numbers despite physical and chemical enhancement. The enzymatic systems of some generic microorganisms may be inadequate for degrading a waste and, therefore, addition of microorganisms specifically cultured on target waste as a carbon energy source may greatly enhance the biodegradation activity (Becker *et al.*, 1985).

A fundamental understanding of a microbes degradative potential under various conditions, its bio-chemical systems and its
molecular biology are vital in maximising the potential benefits of microbial community in combating pollution problems (Deo et al. 1994).

Most of the studies on bio-degradability of organic pollutants have been focussed on treating one chemical with a particular organism (Grimes and Morrison, 1975; Hill, 1978; Gibson, 1980; Stucki et al. 1981; Philippi et al. 1982; Loper et al. 1984; Janssen et al. 1985). Polychlorinated biphenyls are known to be metabolised slowly by Alcaligenes, Acinetobacter, and Klebsiella to 4-chlorobenzoic acids in pure culture (Furakawa et al. 1979; Kamp and Chakrabarty, 1979.). The Alcaligenes or Acinetobacter sp. can also convert di and tri-chlorobiphenyls to their respective chlorobenzoic acids which are not further broken down by the pure culture and therefore accumulate in the medium (Chatterjee et al. 1981). Focht and Alexander (1970) demonstrated the complete mineralisation DDD and other DDT metabolites by a Hydrogenomonas Sp. under aerobic conditions. DDT mineralisation by Pseudomonas aeruginosa under sequential anaerobic and aerobic conditions was reported by Golovleva and Skryabin (1981). These studies have revealed the metabolic pathways that are involved in metabolism of microorganism on a particular chemical. The subsequent genetic engineering laboratory studies have resulted in the development of organisms that can degrade specific compounds. This reduces the complexity of the system and ensures reproducible results. But these "organisms - chemical specific" studies give no indication as to how will the organisms react in the presence of more readily degradable compounds or in a mixture of compounds or in natural conditions. Pure culture studies do not
exactly give the information about the behaviour of mixed cultures, where interactions among population are common. The compound in question may be degraded by a microbial mixture of consortium with no single organism possessing all the required characteristics (Bull, 1980; Harder, 1981).

An adjunct to the process of bio-degradation of waste is the production of useful substances like alcohols, organic acids, combustible gases, proteins and harvestable cell material of the degrading micro-organisms from the waste material. The broad range of pollutants in the industrial effluents places considerable demand on the microorganisms responsible for pollutant degradation.

Orchard and Goodfellow, (1980) discovered a diagnostic sensitivity test agar was selective media for diverse Nocardia asteroids strains. Another development has involved tailoring selective media to the nutritional requirements of the target organisms. Vickers et al. (1984), and Williams et al. (1984 and 1988), used particular combinations of carbohydrates and amino acids, with and without antibacterial antibiotics, to favour the outgrowth of members of uncommon streptomycete species known to be promising sources of antibiotically active metabolites, or to inhibit the growth of *Streptomyces albidosflavus*. However, according to Bull (1992) the isolation plates carry a variety of interacting bacterial colonies so that modifications to the media can influence the growth of several species, which in turn stimulate or discourage the growth of others.
Industrial wastewater is as varied in quality and quantity as are in the industries. The wastewater characteristics, among industries, also differ widely and depend on many operational factors and plant measures (Rosenwinkel, 1983). These industrial wastes can be divided into two major categories on the basis of their biodegradability: firstly, the inorganic wastes which are not amenable to the biological degradation. (Taylor, 1965; Becker et al., 1985) and secondly, the organic wastes which are amenable to the biological degradation.

Biodegradation can be defined as the degradation and assimilation of organic polymers by the action of living organisms, primarily bacteria and fungi (Potts, 1984). In general, bacteria have been found to play a major role in the biodegradation of organic polymers in aquatic environments. (Rublee and Roman, 1982; Brock, 1984; Benner et al. 1986, Gaur et al. 1992).

The process of biodegradation is influenced by any condition that affects the activity of the microorganisms. The activity may consequently be enhanced by additives or environmental controls. (Becker et al. 1985; Krimsky and Franknel, 1985)

Microorganisms possess a metabolic machinery of immense versatility, aiding the breakdown of various natural products and xenobiotics. In the course of evolution and with rapid industrialisation, microorganisms have been exposed to numerous chemicals, thereby adapting to their presence by developing the necessary enzymes, which aid in metabolising such chemicals. However, biodegradation is not feasible if the compounds have structural features never ever found in natural compounds or if microorganisms have never encountered them during evolution.
(Harder, 1985). A comprehensive use of the term biodegradation however, obscures other effects, which are as much significant; namely — mineralisation, detoxification, co-metabolism, activation and defusing. (Alexander, M., 1980).

Co-metabolism, wherein the xenobiotics though metabolised, does not serve as a source of nutrient and energy, plays an important role in biodegradation. This process indicates a lack of substrate specificity of some of the microbial transport mechanisms and enzymes. The significance of co-metabolism is largely unknown. It however, demonstrates that, for biodegradation to occur, it is not essential for the compound or chemical to serve as a sole source of carbon and energy. (Ashok and Saxena, 1995).

The common groups of microorganisms responsible for degradation are bacteria, fungi and yeasts. Bough et al. (1972) reported the use of \textit{Bacillus megaterium} for the treatment of meat packing waste. Enough literature is also available on microbial degradation of xenobiotics, especially the most persistent chlorinated organic compounds. Important to mention are microbial degradation of organic compounds in biosphere by Dagley (1975), biodegradation of chemicals of environmental concern by Alexander (1985), anaerobic degradation of haloaromatics by Reineke and Knackmuss (1987) biodegradation of halogenated organic compounds by Choudhery and Hapalamadugu (1991), microbial reductive dehalogenation by Mohn and Tiege).

Literature is also available on the degradation of phenol by \textit{Bacillus stearothermophilus} of coal by \textit{Pseudomonas aeruginosa}. It is also observed that \textit{Pseudomonas} can degrade 3-chloroquinolene (Kynurine), pulp mill effluent. Microbial
degradation of a range of organic compounds has been reviewed by Slater and Somerville (1979). Mechanism for the breakdown of a number of aeromatic compounds were given, and a possible, but unproven, model for the bacterial degradation of DDT were discussed. Treatment of an industrial wastewater containing chlorophenols has been effected using an anaerobic fluidised -bed biological reactor (Hakulinen and Salkinoja-Salonen, 1981).

Degradation and disposal of toxic wastes, including cyanide, formaldehyde, phenol, antibiotics, hormones, herbicides and pesticides have been reviewed by Howe (1969). Detailed reviews have been produced on the microbial breakdown of pesticides (Cripps, 1971), synthetic polymers (Eggins, et al (1971), surfactants (Cain, 1977) and herbicides (Wright, 1971).

As oil is an important commodity involved in some way in virtually every activity of contemporary life, there is an obvious concern about its polluting effects. Industrial oil wastes can be treated by the standard biological processes though with an upper limit of about 50g/m³ of oil in aqueous waste for successful biodegradation (Hill, 1977). Biodegradation in marine environment is of obvious importance in breaking down oil spillages at sea, and microorganisms having the ability to oxidise hydrocarbons are relatively abundant in waters subject to persistent oil pollution (Beastall, 1977). Dispersion of oil is an important factor in exposing additional surface area of oil to microbial attack, but the use of dispersing chemicals is not necessarily useful as it appears that the dispersing must be degraded before the oil becomes available for microbial attack. Vigorous agitation giving dispersal and enhanced aeration increases the rate of breakdown. Addition of supplementary
microbial nutrients such as N and P is practically only in enclosed areas. As in other biodegradation processes, a mixed microbial population is needed for oil degradation, as different species and strains of organisms have specialised breakdown capabilities.

So far, very few attempts have been made to characterise the bacteria from the wastewater of the industries, particularly with reference to identify them. Hence, the following objectives were set for the present investigation.

(1). Survey of Industries situated in and around Raipur city as well as some larger Industries of Chattisgarh Region.

(2). Identification of industries generating wastewater in large quantities so that at least a part of liquid effluent should be flowing outside the Industrial area.

(3). Identification of at least one or more of peculiar chemical features specific to that of wastewater. Recovery of bacteria from wastewater of some selected industries through culturing them in one or more media.

(4). Isolation and identification of those bacteria which are able to grow or are obligate to specific features of wastewater of selected industries.

(5). Isolation and identification of bacteria if any, able to degrade substances considered to be toxic to the environment.