Environmental Hazards of Lignocellulosic Wastes Discharge from Pulp Paper Mill Industry and their Bioremediation

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Pulp paper effluent containing lignocellulosic wastes mixed with pulping chemical is a major source of environmental pollution. The discharge magnitude of wastewater is 160-200 m3 per tone of paper production containing chlorolignin, pentachlorophenol, resin acids, lignosulfonic acid, chlorinated hydrocarbon, plasticizers, biocides, heavy metals. The discharged effluent is also known as black liquor. Though the degrability of these compounds at primary and secondary stage has been reported by various potential bacteria i.e. *Serratia marcescens* (GU193982), *Klebsiella pneumoniae* (GU193983), *Pseudochrobactrum glaciale* (FJ581024), *Providencia rettgeri* (GU193984), *Pantoea sp.* (FJ755943), *Citrobacter freundii* (FJ581026), *Citrobacter sp.* (FJ581023), *Paenibacillus sp.* (AY952466), *Aneurinibacillus aneurinilyticus* (AY856831), *Bacillus sp.* (AY952465). The major metabolic products eg. 2-methyl-2,4-dimethoxy butane, 4,5-octanediol,3,6-dimethyl, Cyclohexanecarboxylic acid, 1-Phenyl-1-nonyne, 2,5-Piperazinedione,3,6-bis (2-methyl propyl), Propanoic acid, 1,1-Diethoxy ethane, 2-Methyl-dodecane, 2-Ethoxyethoxy-Trimethylsilane, have been detected. However, the effluent even after secondary treatment is still threat to environment and posing ecological risk. Therefore, the study has been focused to characterize the residual organic pollutants of pulp and paper mill effluent after biotreatment in industry and their degradability with biostimulation process. The major identified compounds were as 2, 3, 6-Trimethyl phenol; 2-methoxyphenol; phenol,2,6-dimethoxy or syringol; methoxy cinnamic acid; pentadecane; Octadecanoic acid. The majority of these compounds are listed under endocrine disrupting chemicals (EDCs) as environmental toxicants. This indicated that significant amount remains as residual compounds during secondary treatment. However, the supplementation of carbon (glucose 1.0%) and nitrogen (peptone 0.5%) biostimulated the degradation process. Therefore, degraded sample after biostimulation process showed either disappearance or generation of metabolic products at optimized conditions i.e. rpm (150), temp (37±1°C) after 3 and 6 days of bacterial incubation. Isolated potential autochthonous bacteria were identified as *Klebsiella pneumoniae* IITRCP04 (KU715839), *Enterobacter cloacae* strain IITRCP11 (KU715840), *Enterobacter cloacae* IITRCP14 (KU715841) and *Acinetobacter pittii* strain IITRCP19 (KU715842). In addition, the study also revealed that there was a generation of lactic acid, benzoic acid and vanillin as value-added products during the detoxification of effluent in the biostimulation process from residual chloro-lignin compounds. This also supported the commercial importance of this process.

Keywords: Androgenic compounds, degradation, Lignocellulosic waste, residual compounds