Technologies For Treatment Of Industrial Effluent From Pulp And Paper Industries

Introduction:

Pulp and paper industry is one of the major industries that consume enormous amount of water, natural resources and generate large amount of polluted water from various unit processes. This pulp and paper industry is an energy intensive manufacturing process because the energy cost was almost 13% of its total production costs.

Source-

https://en.wikipedia.org/wiki/Pulp_and_paper_industry#:~:text=The%20pulp%20and%20paper%20industry,and%20other%20cellulose%2Dbased%20products

http://kchbi.chtf.stuba.sk/upload_new/file/Miro/Proc%20problemy%20odovzdane%20zadania/Moln%C3%A1r/fleiter2012.pdf

Industrial effluents from pulp and paper mills are loaded with recalcitrant compounds and are responsible for pollution. An activated sludge method is frequently used for treating these compounds.

Source- **https://www.mdpi.com/2073-4441/11/11/2393/pdf**

Manufacturing Processes of Paper and Pulp Industry –

Manufacturing process involves:

- Pulping, to separate and clean the fibers
- Beating and refining the fibers
- Diluting to form a thin fiber slurry
- Suspended in solution
- Forming a web of fibers on a thin screen
- Pressing the web to increase the density of the material
- Drying to remove the remaining moisture
- Finishing, providing a suitable surface for the intended end use.

Source-

https://link.springer.com/article/10.1007/s13204-011-0051-y#:~:text=Preparation%20of%20silver%20nanoparticles%20have,on%20cotton%20and%20silk%20fabrics.

Paper and Pulp Industry Manufacturing and Treatment Processes -A Review – IJERT

http://environmentclearance.nic.in/writereaddata/form-1a/homelinks/TGM_Pulp%20and%20Paper_010910_NK.pdf

Industrial Effluent Generation and Characteristics–

Industrial effluent can be distinguished from municipal wastewaters as they mostly consist of mixture of dyes and other toxic chemicals.

Source-http://environmentclearance.nic.in/writereaddata/form-1a/homelinks/TGM_Pulp%20and%20Paper_010910_NK.pdf

Pulp-and-Paper Industry: An Important Source of Wastewater:

Wastewater is generated in various processes of the pulp-and paper industry, including wood debarking or chip making, pulp for manufacturing and bleaching, paper manufacturing and fiber recycling.

Source-
http://kchbi.chtf.stuba.sk/upload_new/file/Miro/Proc%20problemy%20odovzdane%20zadania/Moln%C3%A1r/1-s2_0-S0301479715300621-main.pdf

Materials And Method:

- Pulp and paper industry wastewater
- Sequencing Batch Reactor (SBR) Setup
- Feed composition
- Acclimation period
- Analytical method (Close –reflux Method)

Source-https://www.ijser.org/researchpaper/TREATMENT-OF-PULP-PAPER-INDUSTRY-WASTEWATER.pdf

https://www.sciencedirect.com/science/article/abs/pii/S0959652617319807

https://www.mdpi.com/2073-4441/11/11/2393/pdf

Minimum Standards for Pulp and Paper Effluents:

Source-https://www.irjet.net/archives/V2/i4/Irjet-v2i4235.pdf

http://cca.urban-industrial.in/live/hrdpmp/hrdpmaster/igep/content/e48745/e49028/e51797/e52844/02_PulpPaperSector-RegulatoryOverview_BRNaidu_CPCB.pdf

BIS Standards for Pulp And Paper Industries - http://cca.urban-industrial.in/live/hrdpmp/hrdpmaster/igep/content/e48745/e49028/e51797/e52844/02_PulpPaperSector-RegulatoryOverview_BRNaidu_CPCB.pdf

PARAMETER	LARGE PAPER MILLS	SMALL PAPER MILLS
pH	6.5-8.5	5.5-9.0
Suspended Solids (mg/l)	100	100
BOD AT 27^0C(mg/l)	30	Inland: 30 Land: 100
COD (mg/l)	350	-
Total Organic Chlorine (TOCL) (kg/ton paper 1992 onwards)	2.0	-
Sodium Absorption Ratio (SAR)	-	26

Regulatory Provision of Industrial Effluents:

Some of the regulations, the links in the 'Category Overview' column provide a summary of the regulation and available EPA publications for the category. We issue Effluent Guidelines for categories of existing sources and new sources under Title III of the Clean Water Act.

Source-**http://cca.urban-industrial.in/live/hrdpmp/hrdpmaster/igep/content/e48745/e49028/e51797/e52844/02_PulpPaperSector-RegulatoryOverview_BRNaidu_CPCB.pdf**

https://www.epa.gov/eg/industrial-effluent-guidelines#existing

Treatment of Industrial Effluent:

- Wastewater treatment
- Physicochemical treatment
- Greenhouse gas emission
- Biological treatment
- Nutrients removal from wastewater
- Integrated systems
- Advanced and tertiary treatment

Effect of operating parameters on the treatment process - Operating parameters of the treatment process have a major impact on the BOD removal efficiency, energy consumption, effluent quality and the type and concentrations of end-products.

Source-
http://kchbi.chtf.stuba.sk/upload_new/file/Miro/Proc%20problemy%20odovzdane%20zadania/Moln%C3%A1r/1-s2_0-S0301479715300621-main.pdf

https://en.wikipedia.org/wiki/List_of_wastewater_treatment_technologies

Wastewater treatment in the pulp-and-paper industry: A review of treatment processes and the associated greenhouse gas emission - ScienceDirect

Technologies for Pulp and Paper Industry Effluent Treatment:

- The preferred process combination for each individual case depends on the grade-specific quality of the effluent that is going to be treated. There are various types of technologies are:
- Sedimentation technology - Sedimentation technology is the simplest and most economical method of separating solid substances from the liquid phase.
- Anaerobic technology - anaerobic treatment of industrial effluents has found widespread application in the pulp and paper industry. Several hundreds of installations are treating a large variety of different pulp and paper mill effluents.
- Aerobic technology - In effluent treatment, oxygen is supplied to the effluent in the form of air by special aeration equipment.
- Filtration Assisted Crystallization Technology (TNO) - Filtration Assisted Crystallization Technology (FACT) is a hybrid process, patented by TNO, combining heterogeneous crystallization and a simple filtration
- Multifo-softening technology (Veolia)
- Softening and controlled precipitation technologies
- Ozone/AOP technologies
- Membrane technologies (UF, NF, RO)
- 3FM technology (Flexible Fibre Filter Module)

Source-

https://www.pulpandpaper-technology.com/articles/waste-water-treatment-solutions
https://en.wikipedia.org/wiki/List_of_wastewater_treatment_technologies

Integrated strategies for value addition of paper-pulp industry waste

- Pretreatment methods for valorization of PPI waste- Physical, Chemical, Microbial and Enzymatic pretreatment methods.
- Biorefinery technologies to manufacture value-added chemicals, fuels and electric power

Source-
https://www.researchgate.net/publication/332534131_Valorization_of_paper_and_pulp_waste_Opportunities_and_prospects_of_biorefinery

https://www.researchgate.net/publication/285935275_Biorefinery_in_the_Pulp_and_Paper_Industry

Environmental issues in pulp and paper industry:

- Chemical recovery systems
- Discharge and emission norms for pulp and paper industry have been formulated in early nineties based on the technological and environmental scenario existing then.
- New issues related to Water & Energy Conservation, Control of Absorbable Organic Halides (AOX), Color of Effluents, Non Condensable Gases, Solid Wastes and Product

Source-

http://cca.urban-industrial.in/live/hrdpmp/hrdpmaster/igep/content/e48745/e49028/e51797/e52844/02_PulpPaperSector-RegulatoryOverview_BRNaidu_CPCB.pdf

Prevention Advances That Have Been Implemented Within the Pulp and Paper Industry:

- Chemical recovery systems
- Oxygen Delignification
- Secondary fiber substitution
- Enzyme Treatment of Pulp

Source-

http://cca.urban-industrial.in/live/hrdpmp/hrdpmaster/igep/content/e48745/e49028/e51797/e52844/02_PulpPaperSector-RegulatoryOverview_BRNaidu_CPCB.pdf

Industrial Effluent Guidelines:

Effluent Guidelines are national regulatory standards for wastewater discharged to surface waters and municipal sewage treatment plants. EPA issues these regulations for industrial categories, based on the performance of treatment and control technologies.

Source-https://www.epa.gov/eg

- **Planning And Implementation** - **https://www.epa.gov/eg/effluent-guidelines-plan**
- **Development Of Effluent Guidelines - https://www.epa.gov/eg/learn-about-effluent-guidelines#development**

Conclusion:

Effluents therefore vary significantly in quality depending on the process from which they originate. The pulp and paper industry is a complex one with many different kinds of mills, products and processes. Due to this complexity the requirements of water and effluent treatment at the different points of the manufacturing process vary significantly. However, it is evident that there is a great demand for an effective separation process, not the least due to the increasing rigor of environmental legislation and its enforcement.

Source-

https://www.sciencedirect.com/topics/earth-and-planetary-sciences/pulp-and-paper-industry

http://kchbi.chtf.stuba.sk/upload_new/file/Miro/Proc%20problemy%20odovzdane%20zadania/Moln%C3%A1r/1-s2_0-S0301479715300621-main.pdf