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To Study the Requirement of Implementation of Zero Waste Management Plan for Steel Production Plant (A Review)

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Abstract - Unsustained mining practices have resulted in the overuse of shared resources this year, degrading the environment extensively. Additionally, there is an increase in nursery gas emissions from the generation of vital metals due to a continually growing demand for metals, a decline in metal grades, and complex underused stockpiles. As a result, the mineral preparation and metal production industry frequently finds itself under increasing pressure to advance the overall sustainability of its operations, notably through reducing energy consumption, outflows, and waste transfer. Large volumes of wastewater are released by the steel and press industries. Typically, a quantitative approach is used to assess the wastewater's natural effects. In any event, a more notable factor in the harm to the natural environment is the water quality of released effluent. Furthermore, there is still a gap in the thorough assessment of several contaminants in wastewater in terms of both quantity and quality. This work considers the volume of wastewater and the quality of primary forms in order to characterize an add-up to natural affect score that surveys the natural impact of wastewater release. A field check and estimation of wastewater release volume and quality is carried out to secure pH, suspend solids chemical oxygen request add up to nitrogen add up to press, and hexavalent chromium in order to actualize the totally subjective and quantitative appraisal. Coordination steel plants use five basic materials (discus, water, fuel, and control) in the process of producing steel. It is important to note that steel can be generated at a coordinate office using press mineral as well as at an auxiliary office, which mostly uses recycled steel waste to make steel. The development industry and other building applications use a variety of rolled products (sheets, tin- and zinc-plated sheets, cold rolled groups, steel channels, sheet-metal segments, etc.) and made or drawn products (bars, wires) in conjunction with crude steel. Over time, the idea of a life cycle strategy for the supportability of products and services has received more and more attention.

Keywords: Steel Plant, Zero waste management, Waste management

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INTRODUCTION

Steel is an iron alloy that contains different percentages of carbon along with other elements including manganese, tungsten, nickel, chromium, molybdenum, zirconium, vanadium, and so forth. There are already more than 3000 steel grades listed in a catalog. In 2007, the total amount of steel produced worldwide was 109.3 million tons, a 7.6% increase from 2006.With respective production of almost 100 million tons, China, Japan, and the United States are the three major producers of steel.Per capita, Singapore (1,200kg), Taiwan (nearly 970kg), and Korea (830kg) are the top three consumers.

India's steel production rose from ninth to seventh place in the world in 2006. An examination of historical production data over the past century demonstrates a notable change in the geographic location of steel manufacturing.Compared to now, the United States produces 14% of the world's steel, compared to 37% in 1990.Asian output presently makes up over 40% of global production, followed by Europe (including the former Soviet Union) at 36% and North America at 14.5%, thanks to post-war industrial expansion.The rate of increase in steel production has leveled down since the late 1960s, in part because steel is used more efficiently and waste is reduced.

The development of steelmaking may also be seen in the use of Bessemer converters at the turn of the 19th century, oxygen conversion techniques in the 1950s, and continuous casting in the 1960s.Among

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the non-expendable industrial materials that is recycled the most is steel. All steel production involves the usage of material.Steel can still be salvaged after decades of usage, and waste and recycled materials account for more than 40% of the steel produced today.

Waste Generated In Steel Industry: Causes & Effects

- Cause of Waste Generation

The steel industry is thought to be resource-intensive and environmentally hazardous. Steel production involves a number of steps. Natural raw materials such as coal, iron ores, and fluxes are the first step in the process. Hot metal is produced in a blast furnace, turned into steel, and then rolled into the final product. Within the steel works, a number of additional tasks, such as the manufacturing of refractory, are carried out in varying degrees of intensity. The result of such Activities is the generation of a significant amount of garbage.

Even with quality raw materials and effective operation, one ton of crude steel requires five tons of air, two to three tons of raw materials, and two to five tons of water. In addition, these will yield 0.5 tons of solid trash, 8 tons of moist loaded gasses, and 1 ton of crude steel [Lean, 1990]. This number, however, varies between 820 and 1,200 kg/tonne of crude steel in SAIL plants—quite high [Prothia and Roy, 1993]. All three categories of waste materials—gaseous, liquid, and solid—are produced in the steel sector. The biggest amount of gaseous trash is generated, while the most complex waste is managed using solid garbage.

The 1970s steel factories were distinguished by increased rates of waste generation brought on by large-scale landfills surrounding the steel works, which severely polluted the land, water, and air.
The amount of waste generated in steel works has drastically decreased from 1,200 kg to less than 200 kg per tonne of crude steel over time as a result of technological advancements in the industry, strict environmental regulations and legislation, emphasis on raw material quality, the emergence of new markets, and creative ideas for waste reduction and rescue. In certain regions of the world, recycling rates have reached 95–97%.

Unfortunately, the amount of solid waste generated by the Indian steel industry currently ranges between 600 to 1,200 kg per tonne of crude steel, with a recycling rate that varies from 40 to 70%. These factors contribute to increased production costs, decreased productivity, and worsening environmental degradation.

LITERATURE REVIEW

Group 1: (Waster Water Management in Steel Plant)

Mahdi, et al. 2021 : implemented a hybrid anaerobic-aerobic system to treat wastewater from textile factories. Water is used extensively during the textile industry's production operations. The textile industries mostly use the water for their dyeing and finishing processes. The wastewater from the textile industry is regarded as the most polluting of all industrial sectors when taking into account both the volume produced and the effluent composition. In their investigation, textile wastewater was treated continuously in a combination anaerobic-aerobic reactor.

In an anaerobic reactor, cosm balls were utilized as growth media for bacteria. Investigations were conducted into the effects of pH, dissolved oxygen, and organic changes on the nitrification and denatrification processes. The findings showed that it was possible to achieve over 84.62% ammonia nitrogen and over 98.9% volatile suspended solid (VSS) removal efficiency. It was shown that dissolved oxygen (DO) and pH had very little effect on the nitrification process; in fact, only 3% of pH changes were obtained for every 10% reduction in nitrogen.

A Josef i, et. al., 2017 : They came to the conclusion that high strength textile wastewater may be treated by the combined anaerobic-aerobic system. Ammonia nitrogen, BOD, COD, and VSS were removed to a maximum of 84.62%, 63.64%, 60%, and 98.9%, respectively. Ammonia nitrogen, BOD, and COD contents in the final effluent were determined to be 1.11 mg/l, 13.17 mg/l, and 108.75 mg/l, respectively. It was discovered that dissolved oxygen and pH had very little effect on the nitrification process; only 3% of pH alterations were obtained for every 10% reduction in nitrogen. The gentrification rate was 0.06 mg NO3/VSS at 28% COD/NO3 changes, and this rate will decrease when the dissolved oxygen concentration rises.

Fayza et. al., in 2024 : carried out a study on the treatment of industrial wastewater with chemicals. A business that produced plastic shoes as well as one that produced chemicals for building and construction were examined. Wastewater from the two enterprises is released into the public sewer system. The findings demonstrated that there was a significant level of organic compound contamination in the wastewater released from the building and construction chemicals factory. COD and BOD averages were 2912 and 150 mg02/l, respectively. There was found to be a 0.3 mg/l phenol content.

The efficacious chemical treatment with lime and ferric chloride resulted in an effluent with properties that met Egyptian permitted limits. In order to reduce the organic load at the other factory, household and industrial effluent were combined. After mixing, the

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COD and BOD readings were 5239 and 2615 mg02/l, respectively. The mean phenol concentration was 0.5 mg/l. This enhances the toxicity of the contaminants and, as a result, the biological treatment's efficacy. Additionally, since no chemical salts are needed to deliver nutrients, dilution with sewage is less expensive.

Group 2: Zero Waste Management in Steel Plant

Florante et. al., in 2019: conducted a preliminary investigation utilizing aerobic and anaerobic reactors to determine the nitrogen and organic removal efficiencies of a lab-scale system. There was a simulated wastewater that had high nitrogen content. In order to remove nitrogen and chemical oxygen demand (COD) from wastewater that is rich in nutrients, this research compares the effectiveness of aerobic and anaerobic reactors. The experimentation on simulated wastewater utilizing two separate reactors set up as aerobic and anaerobic is also presented.

A 5-liter acrylic aerobic reactor and a 4-liter flask anaerobic reactor with activated sludge from the wastewater treatment plant of De La Salle University (DLSU) as a source of inoculum were used for the start-up tests. The two reactors were continually supplied with simulated wastewater, and the biomass concentration, which is represented by mixed liquor volatile solids (MLVS), was measured to track the increase of biomass over time.

k Rana (2021): Based on the given experimental data, the following deductions were made:Although the aerobic procedure generates a lot of sludge and takes longer to aerate, it can eliminate ammonium nitrogen. The creation of useable biogas and increased organic loading rates are two benefits of anaerobic treatment methods; nevertheless, other drawbacks include comparatively higher effluent concentrations and an inability to remove ammonium nitrogen. Anaerobic bacteria digest organics more slowly than aerobic bacteria, as seen by the 98% drop in COD in the aerobic reactor and the 34% reduction in the anaerobic reactor at the same HRT.

Since NOB activity was minimal in the aerobic reactor during nitrification—possibly as a result of inhibitors or an uncontrolled pH in the reactor—nitrite accumulation and low nitrate buildup were noted. Therefore, using combined anaerobic and aerobic systems for the simultaneous removal of nitrogen and COD is more appealing in light of the aforementioned findings.

Bashaar, (2004), carried out a study on wastewater treatment and characterisation utilizing laboratory-scale anaerobic and aerobic sequencing batch reactors, respectively, from the pulp and paper mill and olive mill industries in Jordan. For these two industrial wastewaters, the nutrient requirements were determined to be lower than the C:N:P ratios of 100:5:1 for aerobic treatment and 250:5:1 for anaerobic treatment, as is typically stated in the literature. This was explained by the wastewaters' comparatively poor removal efficiency and low biomass observed yield coefficients.

It was discovered that a COD:N:P ratio of roughly 900:5:1.7 could remove more than 80% of the COD from effluent from olive mills when treated anaerobically. The biomass output that was measured was around 0.06 kg VSS per kilogram of decomposed COD. More than 75% COD removal was achieved for the extended aeration aerobic treatment of pulp and paper mill effluent with a COD:N:P ratio of roughly 170:5:1.5. The biomass yield that was observed was around 0.31 kg VSS per kilogram of decomposed COD. No nutrients were added to either of these wastewaters. In order to determine nutrient requirements based on removal efficiency and the observed biomass yield coefficient, a straightforward method is presented.

(APHA, 2019). After adding an equivalent volume of raw wastewater, the entire volume entered a new anaerobic mixing phase. Following the startup phase, the reactor's COD was diluted to maintain a level of approximately 16,000 mg/l. To maintain the volatile suspended solids (VSS) content in the reactor as steady and as near to 12,000 mg/l as feasible, sludge wastage was carried out. Three days were maintained as the hydraulic retention period. Sodium bicarbonate was used to bring the reactor's pH down to about 7 as needed. Dissolved oxygen concentrations for the aerobic treatment of wastewater from pulp and paper mills were maintained between 2 and 4 mg/l.

The entire volume entered a new anaerobic mixing phase after an equivalent volume of raw wastewater was added. The COD in the reactor was diluted after the startup phase in order to keep it at about 16,000 mg/l. Sludge wastage was done in order to keep the reactor's volatile suspended solids (VSS) level constant and as close to 12,000 mg/l as was practical. The hydraulic retention period was upheld at three days. The pH of the reactor was adjusted to roughly 7 as needed by adding sodium bicarbonate. For the aerobic treatment of wastewater from pulp and paper mills, dissolved oxygen concentrations were kept between 2 and 4 mg/l.

Furthermore, he came to the conclusion that the wastewater from pulp and paper mills in Jordan as well as wastewater from olive mills had sufficient concentrations of nitrogen and phosphorus, negating the need for the addition of these nutrients, and that the COD:N:P ratio needed for the aerobic and anaerobic treatment of industrial wastewater should be determined using a formula that accounts for the removal efficiency and the wastewater in question (41/EYobs:5:1) rather than using a constant value for all wastewaters or based on loading rate.

(Gašpariková et. al., 2024) Lastly, a selection of seven minor wastewater treatment facilities were made for assessment. These WWTPs, which were created in collaboration with ASIO-SK s.r.o. in Bytča and ASIO s.r.o. in Brno, operate on the principles of anaerobic pre-treatment and aerobic post-treatment. Plants that treat wastewater are designed to handle 5-600 PE. Under appropriate operating conditions, the Slovak Republic's small wastewater treatment plants' water discharge meets the directive.

Group 3: Integrated System for Waste Management

R Robbion *(2022)* : The study provided here can be split into two main categories: evaluation of an actual operational WWTP AS-ANAcomb and laboratory research conducted in reactors AN-I and AN-II. In the aerobic post-treatment experiment, two pilot-scale reactors were utilized. Anaerobic sludge (about 200 l with SS content of 18–22 g/l) was seeded into Reactor AN–I, which is comprised of a primary settling tank, an anaerobic baffled system, an aerobic portion, and a secondary settling tank, as shown in Fig. 1.

Reactor AN-II was started up without an inoculation despite having the same architecture as Reactor AN-I. The two trial plants were set up at the Devínska Nová Ves municipal wastewater treatment facility in Bratislava (about 40,000 PE). From September 1999 until August 2001, both reactors were used in the pilot scale experiments. The influent and effluent's basic wastewater parameters (COD, BOD5, pH, SS, NH4-N, NO3-N, and NO2-N) were observed in accordance with Standard Procedures (A.P.H.A 1985).

Seven actual WWTPs operating on anaerobic-aerobic principles were selected for examination in the second section; three were for 20 PE, two for 200 PE, and one for 250 PE. The samples were collected from WWTPs located in Slovakia's northern regions. The samples were all grab samples that were taken from the WWTP's effluent five times between August and October of 2003. The samples underwent assays for COD, BOD5, pH, SS, NH4-N, NO3-N, and PO4-P in accordance with Standard Procedures (A.P.H.A 1985).

(Gašpariková et. al., 2004). Their research revealed that the integration of anaerobic and aerobic technologies resulted in an integrated system. Based on operational experiences, it can be concluded that the two-stage method, when used correctly, effectively removes suspended particles and organic pollutants. In ideal circumstances, it can also remove nutrients. Approximately 25–40% less energy was used than in the small WWTP that operated on aerobic principles. The reduction of the specific sludge generation by 40% was confirmed by the AS-ANAcomb's operation. The WWTP operates properly and doesn't have any major issues when it restarts itself repeatedly.

The AS-ANAcomb's operation revealed certain issues that reduced the effectiveness of the treatment. In many circumstances, the accumulation of materials that shouldn't go into WWTPs—such as grease, oil, solvents, and cleaning agents—can be the source of this. Another factor that may cause disturbance is variations in the wastewater flow. It is possible to assess the selected AS-ANAcomb WWTPs' performance favorably. Without expert operation, most of the selected WWTPs were effective in eliminating organic pollution, which is one of the most crucial specifications for small wastewater treatment facilities. Even in a nation with a temperate temperature, the results of the WWTP operation demonstrated the practicality of an integrated anaerobic-aerobic system for the treatment of municipal wastewater.

SUMMARY OF LITERATURE REVIEW

In order to produce steel, an integrated steel mill needs a wide range of raw materials, energy, and other resources. During this conversion process, significant amounts of solid, liquid, and gaseous waste are produced. The management of solid waste generated at the rate of 1000 kg/tonne of crude steel production is a challenging issue, although liquid and gaseous wastes are easily managed. The majority of wastes are deposited in exposed, low-lying locations, which creates issues with disposal and the environment.

The current state of waste management has drastically changed as a result of regulatory authorities placing more pressure on business to preserve the environment and find solutions to the dumping dilemmas. In this regard, business is motivated to recycle and reuse waste materials as much as possible. The Indian steel industry currently generates between 600 and 1000 kg of solid waste per tonne, with recycling rates ranging from 40 to 70%. This results in increased production costs, decreased productivity, and worsening environmental conditions. However, before any further processing, all of these wastes must be classified for efficient utilization at a fair price.

CONCLUSION

Waste is a byproduct of inefficiency in any given operation. Waste does not exist in nature. The transition of materials between states is governed by natural laws. We assign the values of waste to a particular circumstance based on our intentions and goals. Waste is defined as everything that is undesired or useless. However, anything that is unsuitable in one trade may be profitable in another, and something that is unpleasant in one context may be valuable in another. It is up to the human mind to find methods and strategies, create new markets and businesses, and create cutting-edge technology to make profitable use of what might otherwise seem like trash. All mining and industrial operations will inevitably produce byproducts.

So long as their intrinsic values and scope of utilization are not understood, these remain as waste or discarded materials and pollutants

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