AUTOMATED EFFLUENT TREATMENT PLANT

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Introduction:

Water, a critical natural resource, serves diverse purposes from household use to vital industrial applications. However, industrial water usage often leads to contamination, necessitating efficient treatment systems. Effluent Treatment Systems (ETS) address this, crucial in industries like textiles, medicine, leather, and chemicals. ETS aims to purify industrial effluents, preventing polluted water release into nature. Without treatment, clean water availability for domestic use would suffer. Processes target various contaminants like organic matter, heavy metals, and suspended solids, using batch or continuous flow methods. Introducing Programmable Logic Controller (PLC)-Based Automated Effluent Treatment Systems enhances efficiency. PLC technology, specialized for industrial control and automation, manages treatment seamlessly. Automation optimizes wastewater disposal. Garud Allied Technologies' Electroplating (ETP) system in Machhe industrial area, Belagavi, faces challenges. Manual operation by 3-4 personnel takes 45-60 minutes, posing safety risks and inefficiencies. Improvements are crucial to address operational inefficiencies and safety. Automation of tasks like solvent mixing and pH monitoring optimizes the electroplating process and ensures safety. Electroplating wastewater contains heavy metal ions (chromium, nickel, copper, cadmium, zinc), posing environmental risks due to their toxicity and non-biodegradability. Up to 1000 mg/L of heavy metals can be present, requiring compliance with global environmental regulations. In summary, ETS are vital for purifying industrial effluents, ensuring water quality and environmental safety. PLC-

Based Automated Effluent Treatment Systems offer efficient solutions, crucial for industries like electroplating to meet environmental standards.

Objectives:

To incorporate a PLC Based Automated Effluent Treatment System.

To facilitate ongoing real-time monitoring & control of water levels, temperature, combustible gas levels and Ph parameters. This capability allows for prompt adjustments and proactive responses to avert hazards and prevent environmental damage.

To enhance the efficiency of managing effluent treatment operations, ensuring optimal water flow control, and minimizing the harmful effects of released water.

Methodology:

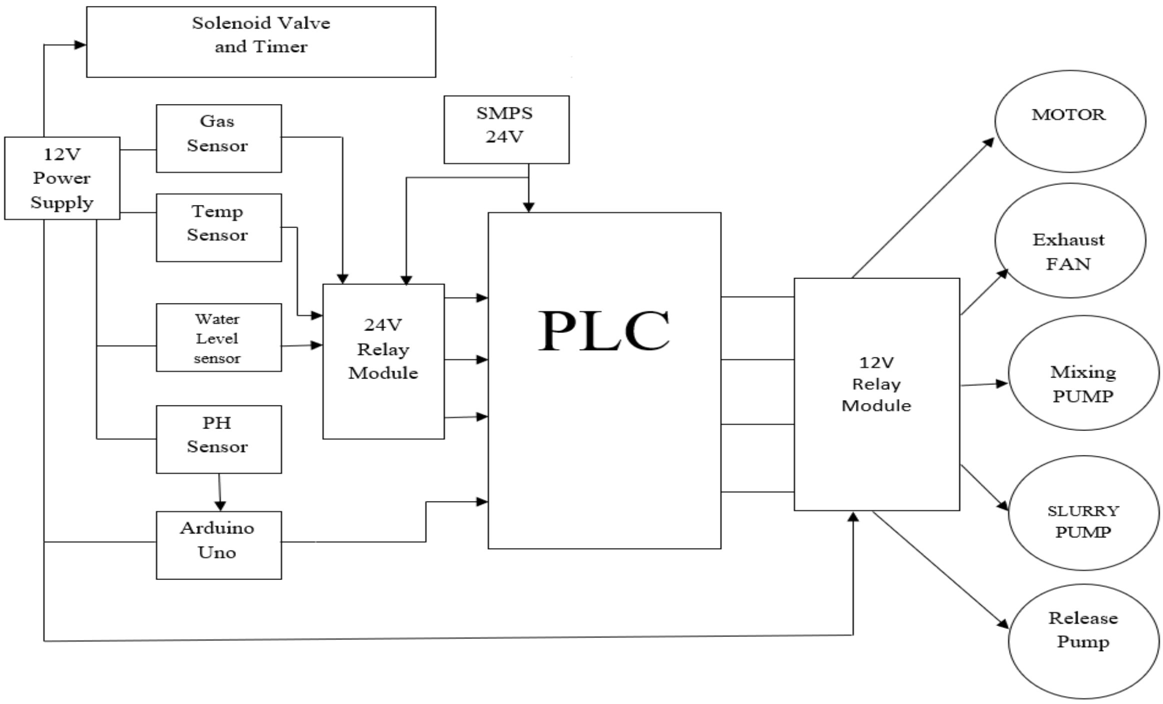

FIGURE 1 BLOCK DIAGRAM

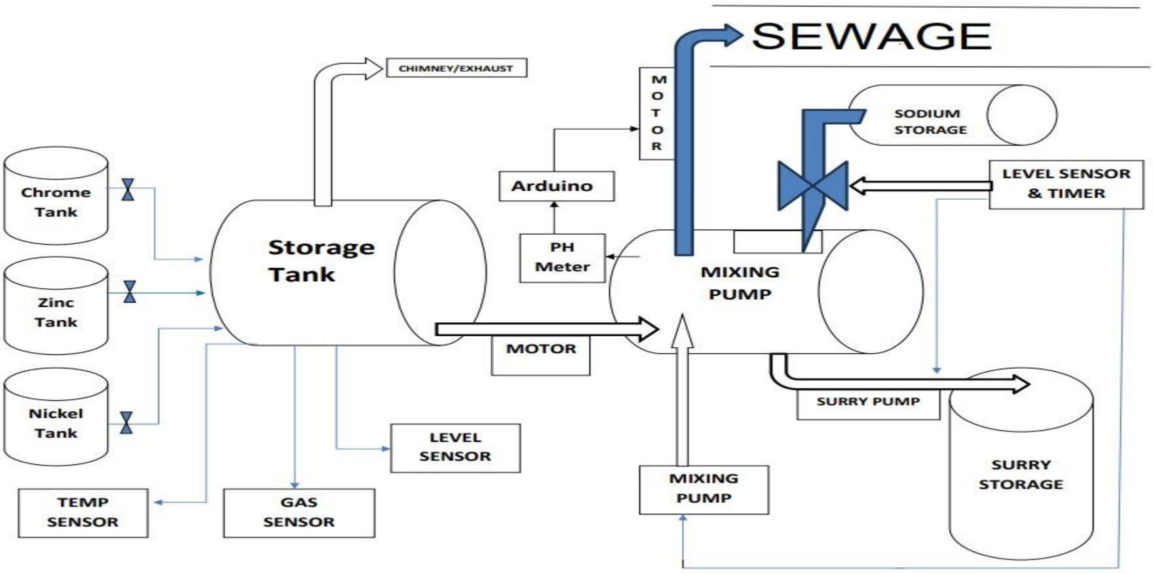

FIGURE 2 FLOW DIAGRAM

In The Electroplating Effluent Treatment Process (ETP), water contaminated with heavy metals and altered pH levels from washing jobs or clearing chemical tanks after electroplating processes (such as zinc, nickel, or chrome) undergoes treatment in a systematic manner. This process involves several key components and sensors to ensure efficient and safe treatment. The contaminated water, along with water used for washing jobs and clearing chemical tanks, is directed into a main tank equipped with various sensors, including temperature, gas, and float sensors. To prevent damage due to excessive heat, a thermistor serves as a temperature sensor, activating an exhaust fan to dissipate heat when high temperatures are detected. Additionally, an MQ2 sensor detects combustible gases within the tank, triggering the fan to expel them, thereby mitigating health risks and fire hazards. A float sensor monitors the water level in the main tank and activates Motor 1 to transfer water to a mixing tank once the water level reaches 80% capacity. The mixing tank is equipped with water level and pH sensors, a slurry pump, a mixing pump, a sodium inlet motor, timers, and an outlet motor (Motor 2). Once the water level in the mixing tank reaches 80%, Motor 1 stops, and the sodium inlet motor adds a specific quantity of water containing sodium into the tank. Subsequently, the mixing pump blends the sodium with the effluent water. During this process, a designated period is allocated for the sodium to neutralize water toxicity, correcting its pH level and reducing heavy metal contamination. The pH sensor continuously monitors the water's pH level within the mixing tank. If the pH level falls within the acceptable range, Motor 2 releases the treated water into the sewage system; otherwise, the system remains on hold until the pH sensor detects the appropriate value. As treated water is released and the water level decreases, another float sensor signals Motor 2 to stop and activates the slurry pump to remove any remaining water and slurry mixture from the tank. Once emptied, another float sensor triggers Motor 1 to initiate the next mixing cycle by transferring water from the main tank. However, Motor 1 starts only when the water level in the main tank exceeds 80%, ensuring an adequate supply for the subsequent process. the ETP process involves careful monitoring and control of various parameters using sensors and automated mechanisms to efficiently treat contaminated water from electroplating processes while ensuring safety and environmental compliance.

Results:

Effluent from the waste area is stored in tank and continuously level, temperature and gases are monitored with help of float temperature and gas sensor of the effluent.

The temperature and gases present in the tank are brought to normal level and released in the environment with help of exhaust fan.

Effluent is transferred to mixing tank as soon the storage tank gets filled up to 80%.

Sodium is poured with help of solenoid valve and mixer is turned on to mix sodium with effluent.

pH sensor senses the pH of effluent continuously and releases the effluent when under the permissible value.

The remaining effluent is successfully made to release in slurry storage with the help of slur pump and cycle is repeated

An industrial automation system comprises various components that operate harmoniously to perform tasks including sensing, controlling, supervising, and monitoring.

Effluents is successfully released with checking of pH and slurry part of mixture of effluent and sodium is stored in slur storage tank.

Future Scope:

Effluent treatment systems are evolving rapidly, incorporating advanced technologies to enhance efficiency, sustainability, and adaptability. One key trend is the integration of cutting-edge technologies such as artificial intelligence (AI), machine learning, big data analytics, and Internet of Things (IoT) sensors. These technologies offer numerous benefits, including optimized process efficiency, predictive maintenance to prevent equipment failures, and improved overall system performance. Additionally, Supervisory Control and Data Acquisition (SCADA) systems, in conjunction with Programmable Logic Controllers (PLCs), facilitate efficient monitoring and management of effluent treatment processes.

Smart monitoring and control capabilities are also becoming increasingly prevalent in effluent treatment systems. Utilizing smart sensors and IoT devices, these systems enable real-time monitoring of crucial parameters like pollutant levels, flow rates, and equipment health. This enables proactive maintenance, automatic adjustments, and remote monitoring and control, enhancing operational efficiency and minimizing downtime.

Efforts to enhance energy efficiency and sustainability are driving the adoption of renewable energy sources, energy recovery systems, and process optimization algorithms. By minimizing energy consumption and greenhouse gas emissions, these measures contribute to a more environmentally friendly approach to effluent treatment.

Modular and scalable designs are gaining traction to accommodate changing treatment needs, emerging contaminants, and fluctuating wastewater volumes. Modular components and plug-and-play systems allow for flexible configuration, easy expansion, and rapid deployment across various industries and applications.

Furthermore, decentralized treatment solutions, such as onsite or point-of-use treatment systems, are becoming increasingly popular, particularly in remote or underserved areas. These solutions offer cost-effective and sustainable alternatives to centralized treatment plants, reducing the need for long-distance transport of wastewater and minimizing infrastructure requirements.