PuraFlo: Centrifugation-Based Water Filtration System to Reduce Turbidity in Water Treatment and Ecosystems

Prawira, Jordan (School: Mountain House High School)

Sediment pollution, a type of water pollution, degrades drinking water quality, disrupts ecosystems, and increases environmental risks. Anthropogenic causes comprise 70% of sediment pollution, costing $16 billion in environmental damages annually (EPA). The project goal is to develop an efficient water turbidity reduction system. PuraFlo was developed with 3 main components (Water Impeller, Centrifugator, Turbidity Separator) and 2 static components (Collector, Floating Platform). The design implements concepts of Porifera's hyperbolic geometry, the hurricane's logarithmic spiral, and rotational motion's relative acceleration. PuraFlo, a centrifugation-based water filtration system, in 100L of turbid water, successfully reduces turbidity by 34% (1000-664 NTU) over 2.8 hours, using 2 Watts and a prototype cost of $29. PuraFlo maintains an efficiency of 10,989-14,375 mg of sediment/Wh at 1500 RPM for 72 hours. Water Impeller moves water using lift and drag on the blade's hydrofoil. Centrifugator provides an efficient flow path using the hyperbolic geometry with logarithmic spiral grooves. Turbidity Separator removes suspended solids through differential density, separating denser particles from the water. Collector diverts output water. Floating Platform continuously self-adjusts to water level. Solidworks flow simulations supported test results, exemplifying PuraFlo's optimized flow. PuraFlo is the first important step in reducing turbidity in water treatment, minimizing chemical usage, reducing sedimentation time, and potentially saving $453K-$3.5M in annual operating costs in a local water treatment plant in treating 200-1000 NTU effluent. PuraFlo is important as it effectively reduces water turbidity, improves water quality, and mitigates sediment pollution.