

SEMI-AUTOMATED DOMESTIC SCALE SOAP MANUFACTURING UNIT

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The global soap market was around USD 43 billion in 2023 and is expected to grow to USD 67 billion by 2033. Soap prices have been increasing over the years for many reasons, and the current economic crisis in Sri Lanka has also worsened the situation. In this regard, the current project aims to develop a user-friendly semi-automated batch soap manufacturing unit for domestic-scale users to produce soap bars at a lower cost. This also helps in decentralizing the soap manufacturing process. Mixing, heating and moulding are the basic unit operations involved in the unit. A stainless-steel container, which can stand at a higher temperature, was used as the main reactor. Four heat elements (PTC heaters) were attached to the main reactor for heating purposes. A stainless-steel agitator was used to mix the reactants. A motor (RS 775) was used to agitate the reactants, which can speed up to 1200 rpm. Load cells (HX 711) were used to weigh the reactants and products in the main reactor. Small storage tanks were used to store all the reactants. NaCl, H₃PO₄, fragrance and colouring agents were introduced to the reactor using solenoid valves, while mini pump motors (solar pump) were used to pump H₂O and coconut oil to the reactor. A screwdriver was used to introduce NaOH powder to the reactor. A brush DC motor (DC 775) was used to rotate the screwdriver. All the instruments were calibrated prior to use in the unit. The entire setup was powered by SMPS unit (12V,10A). Arduino boards (UNO and Nano), relay modules, display models, I2C bus modules, keypads, and thermocouples were used to semi-automate the operations of the unit. Most of the time, due to the presence of impurities as well as machinery and human errors, the actual mixing ratios of the reactants differ from the stoichiometric ratios. In this experiment, after a few trial-and-error studies, it was found that mixing 50 mL of coconut oil with 15 mL of H₂O and 15 g of NaOH is the best combination to produce the soap bar. These promising results encourage the commercialization of the unit. Further studies are planned to improve the quality of the produced soap from the setup.

Keywords: *Soap manufacturing, Process development, Semi-automation.*