SOLINAS

Product Design Challenge

Team **40**

01 Introduction

The project aims to develop a shaft assembly intended to homogenize a semi-solid waste water mixture in a tank. The innovative design tries to incorporate several key features, which revolve around User friendliness, felxibility, rigidity & durabiliity, reachability & portability.

02 Components & Design Principles

2.1 Mount

The Mount **Fig. 1** is the main body of the product. A cylindrical component which provides stability & rigidity. It provides a handle for the user which contains - a **thumb operated power button**, a toggle button to facilitate switching on or off the electrical components like the motor, and a **grip lever** to facilitate the retraction and expansion of the shaft. Thus, the easily accessible handle provides switches for shaft and power control.

The mount can be handheld or placed on the container tank's rim. On the bottom of the tank, runs a peripheral groove containing wheels, extending the mount's ability to move of the tank's upper surface, in case need arises. Center of the mount has a circular cutout which houses the motor & spool.

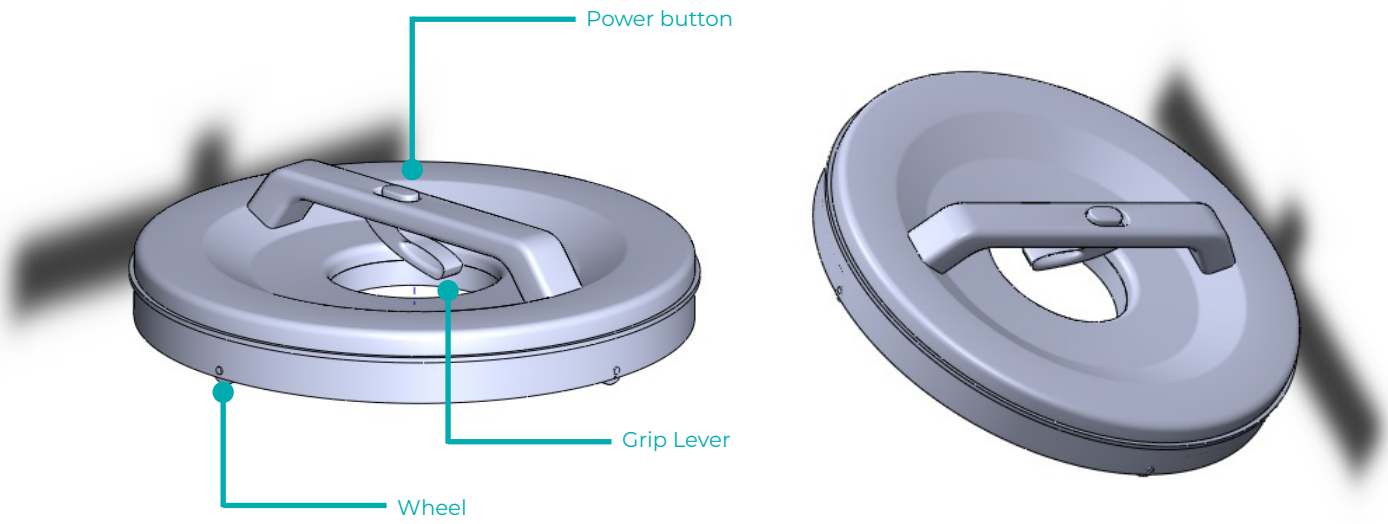

FIG 2 MOUNT BODY

2.2 Spool

The spool located in the cavity in middle of mount body, contains a **motor** Fig 2 at its top and acts as the home for retracted shaft. It is responsible for retraction, storage and expansion of shaft, controlled by the motor above. Instead of a trivial cylindrical spool, this one has a conical frustrum like shape. It has two hulls - one inner and one outer, along with grooves which are designed to perfectly fit the retracted shaft between both the surfaces. The bottom of spool is the outlet for the shaft, equipped with a **waterproofing rubber ring,** meant to wipe off the water from shaft during retraction. Below the spool are two spring attached **feed rollers** (driven by two servo motors) which assist the expansion and retraction of shaft.

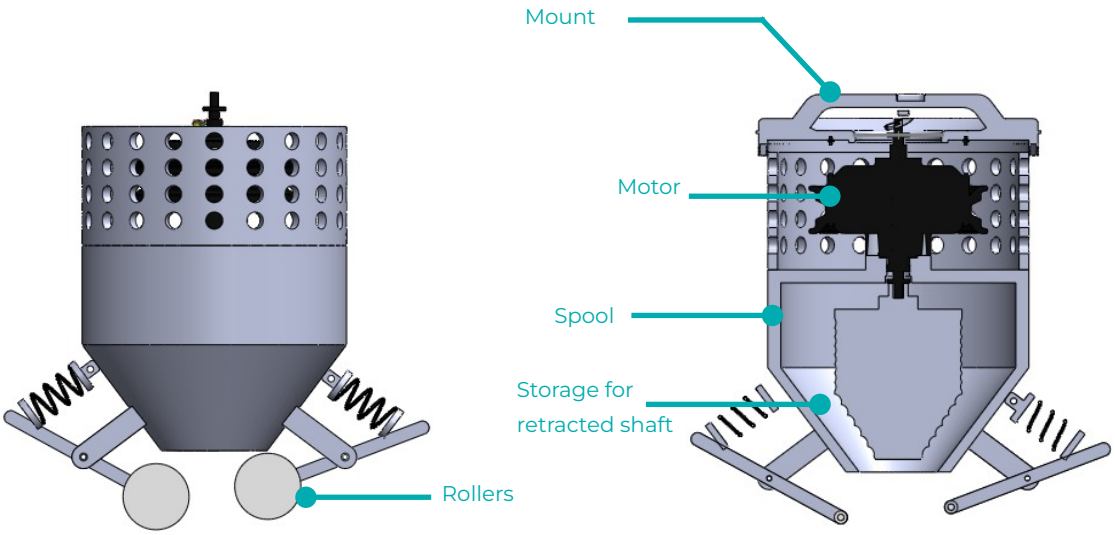

FIG 2 SPOOL

2.3 Shaft

The most integral part of the product, the shaft is designed to be flexible & retractible but at the same time rigid. It consists of a **coaxial tube** for **solvent delivery** (incase the the slurry below is way too concrete or dry). The solvent storage, facilitating the solvent delivery mechanism is located at the mount body. The coaxial tube is further wrapper with intertwined nylon fibres, which provide strength & rigidity to the shaft, while maintaining its flexibility and retractibility.

2.3 Paddle

The paddle, shown in **Fig 3** facilitates the mixing of the slurry. It consists of four blades, conncted to the main shaft via arms having **slider crank mechanism,** mimics the opening and closing of an umbrella. This feature gives the user control over the span of paddle blades. Also, the baldes' folding eases retraction incase of bottlenecks of tanks and enhances portability to a great extent.

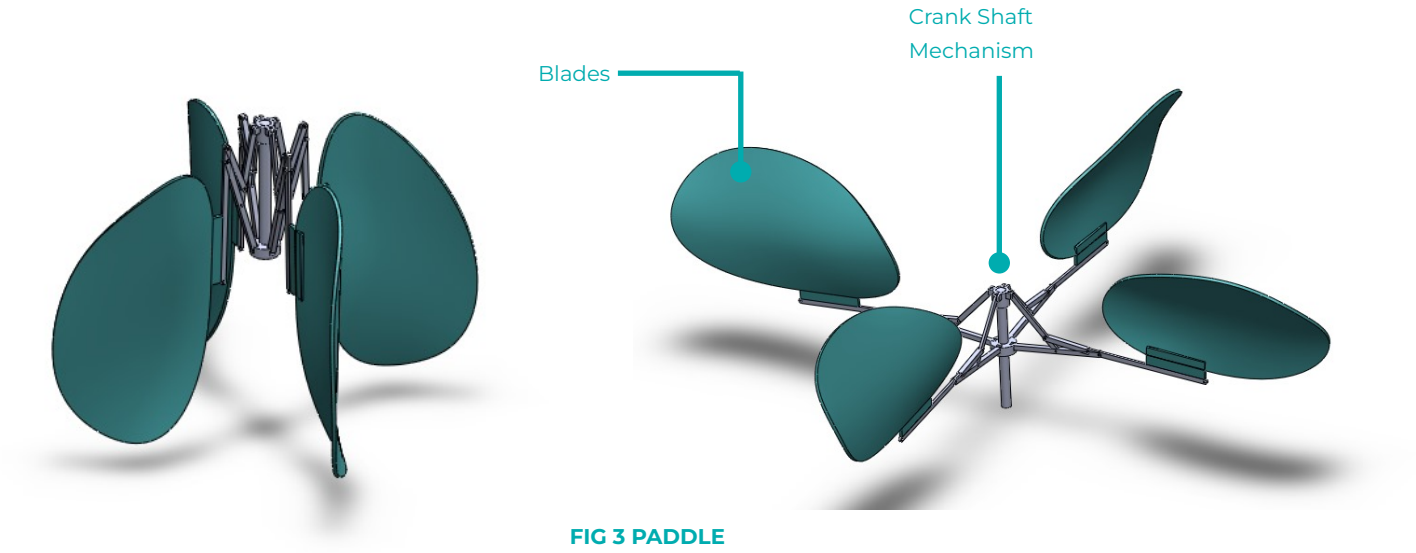

FIG 3 PADDLE

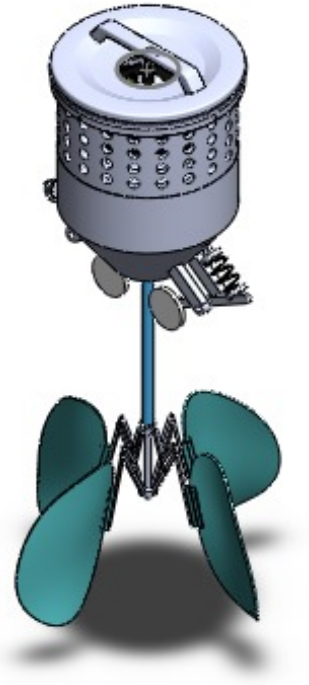

FIG 4 Assembly (a)

03 Assembly & Working

The mount is the main body of the entire device, which can be used handheld or placed on the tank's rim. The handle provides power switch and control lever for operational tasks. The cavity in body houses the motor and spool, which stores the shaft on retraction. Retraction and expansion is eased by feed rollers at the bottom of spool. Servo motors help drive the feed rollers for protruding the shaft up and down the tank. The bottom of shaft bears a metallic extension having four blades, assisted by slider crank arms. Thus, the motor on spool top helps rotate the entire shaft and blades, mixing the slurry underneath. **Fig 4,5**

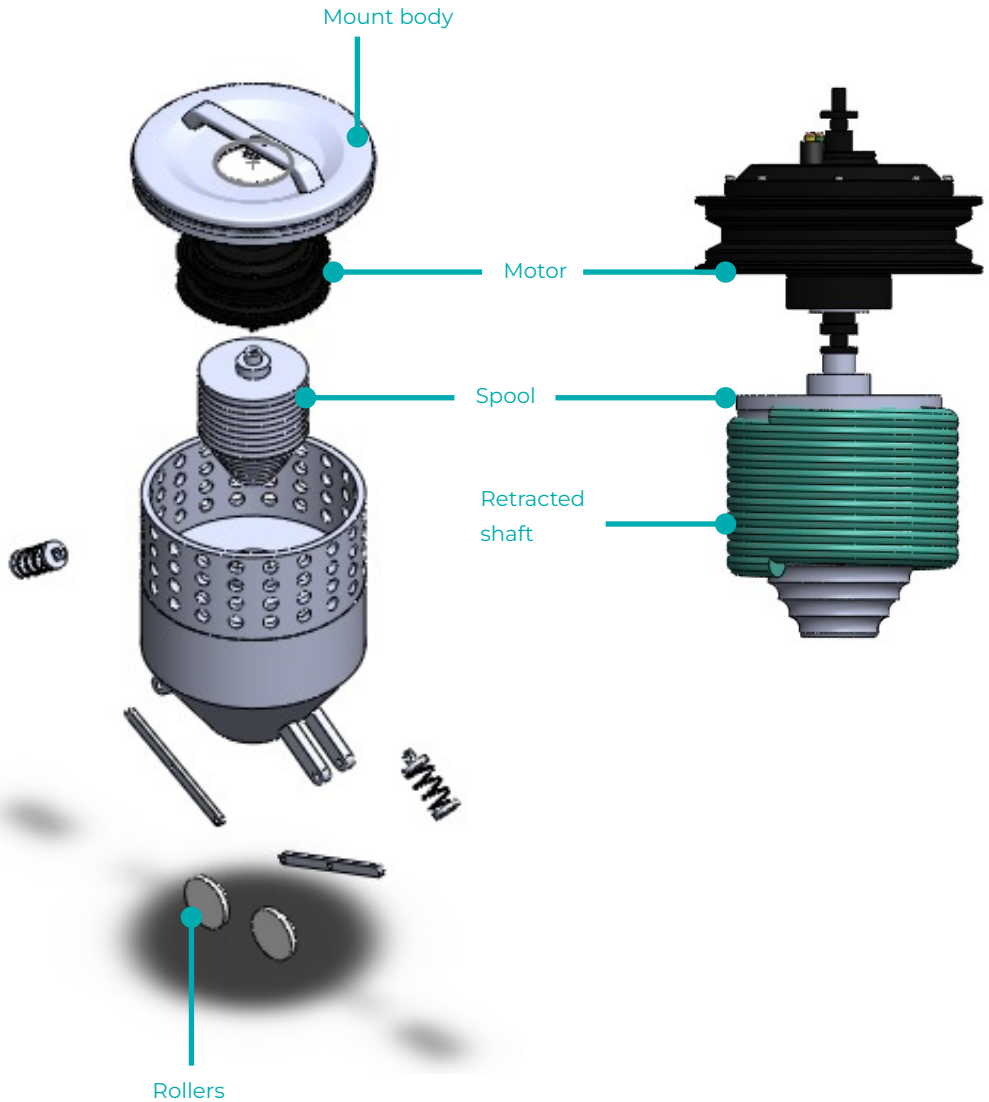

FIG 5 Assembly (b)

04 Dimensions

ALL UNITS ARE IN MM

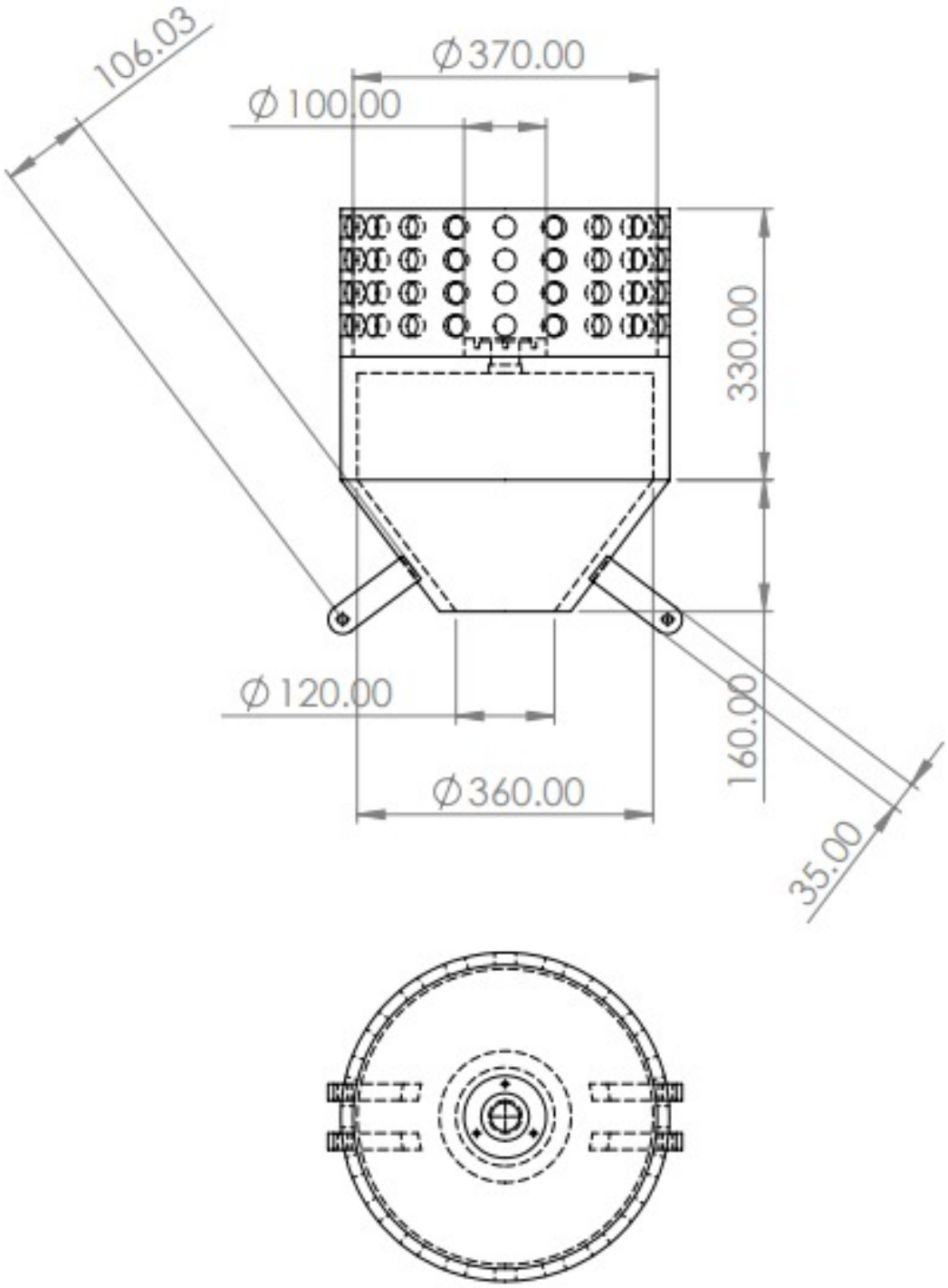

FIG 6 (a)

ALL UNITS ARE IN MM

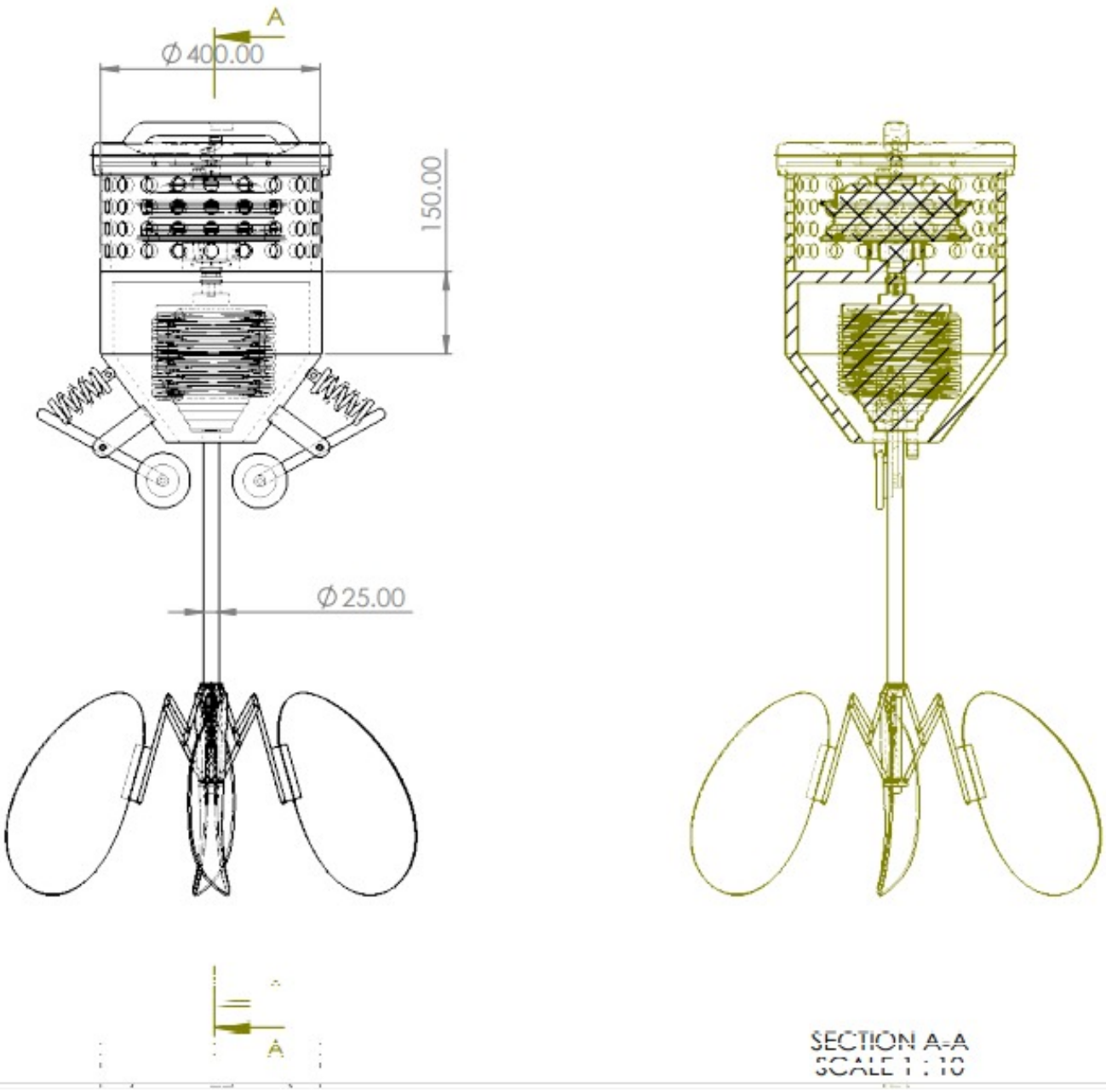

FIG 6 (b)

05 Materials

The mount body is composed primarily of **Aluminum 6061**, which provides high strength, durability & stability to entire structure. Aluminum is lightweight as well.

The motor used for spool rotation is **QSMotor 205 - 500-4kW BLDC Motor 10" rim.** Unlike, portable conventional agitators which use 50cc engines to power their assembly, this is chargeable and provides twice power efficiency.

The shaft's axial solvent pipe is made of plastic for easy bending & inert nature which makes it adaptable to all kinds of solvents as per the needs. The outer intertwined nylon-6,6 fibres, provide strength and flexibility to the shaft, makeing retraction easy. Water repellant properties of **Ripstop Nylon-6,6** enhanced with **durable water repelling coatings like silicone** provides waterproofing features. The silicone coating also provides protection when exposed to sun & harsh conditions.

Paddle blades are composed of **Stainless Steel (SS316)** since it is susceptible to wear and tear. This material is highly ductile, anti-corrosive, rigid & tough and makes the most optimal choice.

The spool & slider crank mechanism supporting the blades is composed of **Stainless Steel (SS304),** since it is cost effective.
The toggle switch and grip lever are composed of recylable & mouldable thermoset plastic.

06 Key Features & Summary

- Intricate dimensional details ensure the assembly's smooth processing and reachability to all parts of container.
- Instead of the conventional metaillic shaft, the current nylon intertwined shaft aims to provide both strength and flexibility. Its axial solvent delivery tube provides solvent if the slurry concretizes.
- The paddle opening-folding mechanism extends portability and reachablity to areas where container's bottleneck might have been an issue. It also provides span as per the requirements
- Innovatively designed spool, lets the flexible shaft easily wind, unwind, retract and remain stored in it.
- The material selection, such as Nylon with silicone coating provide waterproofing.
- Steel blades ensure durability against wear and tear and exposure to chemicals and wastewater. Aluminum has been used in components, not in contact with water, since it is lightweight.
- The lightweight Aluminum mount body having wheels and handles eases operation. The grip lever facilitates shaft movement. In close proximity lies the thumb operated toggle power button which eases swift power off, in emergency situations.