DEPARTMENT OF MECHANICAL ENGINEERING

Mother Shuckers
The Automatic Oyster Shucker

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Problem Definition

Problem: Current manual oyster shucking is slow, dangerous, labor-intensive, and unable to meet industry demands.

Objective: Create an automated machine to safely and efficiently shuck oysters, handling all sizes with minimal human intervention.

Impact: Improve worker safety, reduce labor shortages, significantly increase oyster meat yield, and support oyster industry growth.

Requirements

Universal Compatibility: Handles all oyster shapes and sizes.

Efficiency: Shucks oysters at a maximum rate of 5 seconds per oyster.

Safety: Reduces hand-related injuries and complies with FDA and OSHA standards.

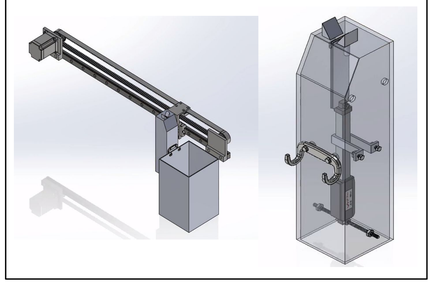
Meat Quality: Cleanly separates meat from shells without damage or contamination.

Minimal Labor: Requires light labor of only loading oysters into chute.

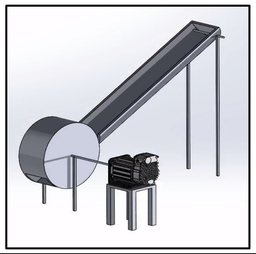
Final Design

Our simple machine consists of three core subsystems: the **Chute**, **Vise**, and **Blade Assembly**. Each subsystem works in sequence to automate oyster orientation, opening, meat extraction, and shell disposal.

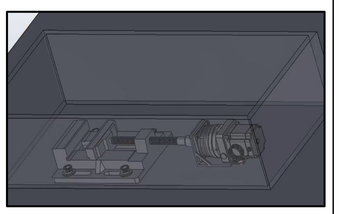
Blade Subsystem



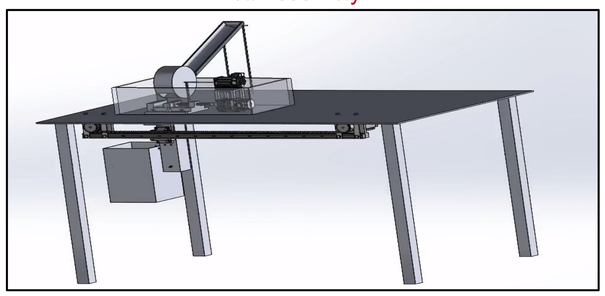
Chute Subsystem



Vise Subsystem



Full Assembly



- Gravity pulls the oyster down the chute into the sorting wheel and ultimately into the vise.
- The vise, powered by a motor, opens the oyster shell.
- Blades enter the oyster, forming to the shell's shape, cutting out the meat.
- Our blade subsystem is powered by a linear actuator so that the blades enter and exit the shell.
- The removed meat falls into a collection bin.

Design Calculations & Decisions

(motor selection)

Assumptions:

- **Vise Model: American Scale No.64**
- 4.5" wide jaws
- Efficiency is 35%-50% (**.45 Avg.**)
- Force applied to handle from testing was **11-16 lbs**
- Thread Per Inch is between .2 and .4 (**.3 was used**)
- Measured handle length was **10"**
- Number of turns averaged at **1.25**

Findings:

The amount of force applied by the vise on the oyster is enough force to fully open the oyster without crushing it and compromising the meat quality.

Design Decision:

- A drill press vise, powered by a NEMA 23 stepper motor, clamps the oyster to crack the shell.
- Linear rails and a flexible coupling guide and stabilize motor motion.

Leverage Calculations:

$$Lead = 1/3$$

$$Leverage = 10"/.333 = 30$$

$$Eff.\ Leverage = 30 * .45 = 13.5$$

$$13.5 \approx 13.5{:}1\ ratio$$

Handle Torque Calculations:

$$Torque_{LL} = (11\ lb) * (10") = 110\ in - lb$$

$$Torque_{UL} = (16\ lb) * (10") = 160\ in - lb$$

Force (on Oyster) Calculations:

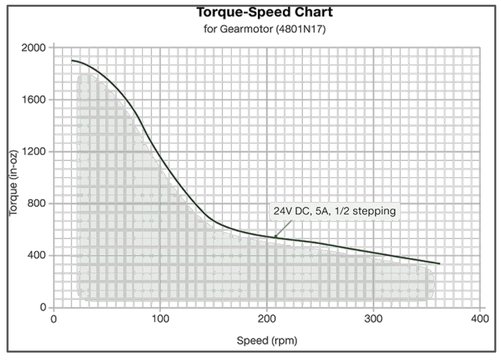
$$F_{LL} = (110\ in - lb) * 13.5 = 1485\ lbf$$

$$F_{UL} = (160\ in - lb) * 13.5 = 2160\ lbf$$

Effective Force (on Oyster) Calculations:

$$F'_{LL} = (1.25) * 1485\ lbf = \boxed{1856.25\ lbf}$$

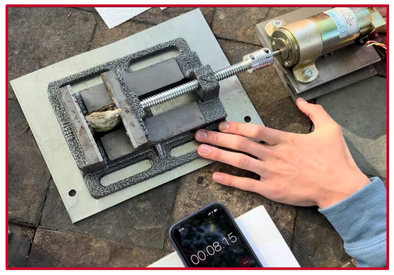
$$F'_{UL} = (1.25) * 2160\ lbf = \boxed{2700\ lbf}$$



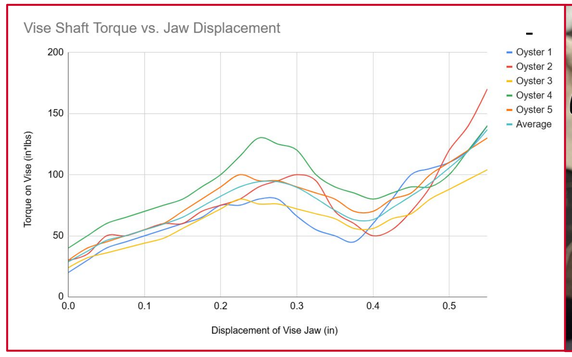
Prototype & Test Results

Early Vise and Motor Assembly Prototype

Linear Actuator in Vise



Vise Prototype Opening an Oyster



Shaft Torque Testing to correlate the distance of the jaw with when the oyster is open. Used for sensing and code development.