Objective

Chlorine tablets treat water more consistently

Only chlorine powder available in underdeveloped regions

Customer Requirements:

- Operable by Average Adult
- Hand-Tool Assembly of Press
- Manually Operated (No Electricity)
- Shelf-Life of Tablets
- Correct Dosing of Water
- Slow Dissolution Rate
- Material Available in Country
- Safe to Operate
- Tablet Must Fit Current Dosing System
- Tablet Easily Removed from Press
- Simple Powder Feeder System for Mold

Design

Operation of Product:
1. Pour chlorine powder into chamfered cylinder
2. Compress hydraulic jack to 12 tons
3. Loosen screw on hydraulic jack/Return jack to lowered position
4. Insert extracting cylinder with chamfered cylinder on top
5. Compress hydraulic jack until chlorine tablet ejects
6. Repeat third step
7. Retrieve tablet for use

Tradeoffs:
- Uses a lot of human energy to meet compression requirement
- Provides tablet chlorine for rain

Customer Requirements Satisfied:
- Tablet Diameter
- Tablet Density
- Geometry of Tablet
- Weight of Tablet Press
- Height of Tablet
- Consistency of Tablet
- Press Material Properties
- Time to Make Tablet
- Compressive Force
- Tablet Height (in)
- Diameter Volume (in^3) Volume (cm^3) Density (g/cm^3) Time (s)

Prototype and Testing

Prototype designed to meet needs of user:
- Simple – potentially uneducated operator
- No power tools

Functionality Testing:
- Create many tablets then measure each tablet’s geometry, density (mass/volume), and time required.
- Force gauge will be used to determine the necessary force the operator must apply to the lever.
- A smaller sample size of tablet will be tested in water for dissolution properties such as rate and chlorine concentration.

Prototype designed to meet needs of user:
- Multiple tablets of differing diameters
- Simple assembly
- No power tools
- Lightweight – transport easily to a remote third-world area
- DFA – assembled with limited resources

Challenges:
- Measuring the compression force experienced inside the cylinder when making a tablet.

Process Summary:
- Assigned the task of creating a purely mechanical press capable of creating chlorine tablets.
- Generated 5 concepts, and selected the one with highest rank from AHP and HOQ.

Future Work:
- Research Chemical Binders for Hypochlorite
- Implement a Prototype With an Optimized Top Plate, which reduces material weight cost.
- Research Vendors of Steel and Aluminum in Peru, to avoid high over-seas shipping costs
- Test the device in the existing chlorination infrastructure in Peru

Changes for Final Design:
- Material change for the compression and ejection die
- Circular reservoir in center plate where die will sit
- Jack with auto-release or spring to return jack to original position
- Jack fastened to bottom plate
- Rounded plate edges to avoid sharp corners
- Fill line for chlorine powder

Test Results and Future Work

Tablet Diameter

Tablet Mass (g) | Tablet Height (in) | Diameter Volume (in^3) Volume (cm^3) Density (g/cm^3) Time (s) | N.A.
--- | --- | --- | --- | --- | ---
1 | 0.360 | 0.060 | 0.275 | 0.695 | 0.10 | 3.45 | 0.0050 | 0.080 | N/A
2 | 0.370 | 0.070 | 0.330 | 0.571 | 0.11 | 3.70 | 0.0050 | 0.080 | N/A
3 | 0.380 | 0.080 | 0.385 | 0.541 | 0.12 | 3.80 | 0.0050 | 0.080 | N/A
4 | 0.390 | 0.090 | 0.440 | 0.510 | 0.13 | 3.80 | 0.0050 | 0.080 | N/A
5 | 0.400 | 0.100 | 0.495 | 0.479 | 0.14 | 3.80 | 0.0050 | 0.080 | N/A
6 | 0.410 | 0.110 | 0.550 | 0.450 | 0.15 | 3.80 | 0.0050 | 0.080 | N/A

Volume vs Mass

Concept Generation

Final Concept: Compression achieved using a hydraulic jack

Final Concept Reasoning:
- Provided a large mechanical advantage
- Greater compressive force
- Does not require electricity
- Greater tablet density

Concept 1: Force transmission achieved using planetary gears

Concept 2: Compression achieved using a worm gear and a ball screw

Concept 3: Converts rotational motion to vertical compression with gears and a lever arm

Concept 4: Compression achieved through using rollers

Market Analysis:
- Designed Specifically for Compone, Peru
- Over 300 water sanitation projects for EWB worldwide

General Need for Product:
- Only chlorine powder available in underdeveloped regions

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- Tablet Diameter
- Minimum Compressive Force

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