LIQUA-FLUSH™
Product Development Details
6/28/15

Marketing:

Determine product specifications:

- Product Name?

  LIQUA-FLUSH™:

- Product Logo?

- Product Aesthetics:
  - How should the product look? What shape? What Size?

  - Should the cartridge fit into the chassis horizontally or vertically;
  - Should the product have various colors or types of plastics? (this will affect the costs of plastic injection expenses)

- Product Features:
  - Buttons:
    - 2 push-buttons for solution concentration selection?
    - Tactile feel push-buttons (metal dome)?
    - Embossed membrane switch?
  - Control buttons located on the top or the side?

- Buzzer for button feedback, low battery alert, low fluid alert
- Automatic flush option?
- LED indicators?
- Adjustable Hangar: In order for the unit to fit a wide variety of toilet tanks, a specially designed hangar would be required;

- Cartridge Features:
  - Cartridge Product Life; With normal setting, 3 months of product life? How many flushes per cartridge?
  - Color Option: Blue dye used in toilet cleaners is used to improve aesthetic appeal, or to act as a tracer (for example in certain toilet bowl cleaners, blue coloration indicates that the product is working). People often associate blue with cleanliness.
  - Types of Sanitation Solutions:
    - General Purpose Unscented;
    - General Purpose Scented (different kinds of fragrances?);
    - Reduced Minerals Additive (i.e. for Hard Water Stains);
    - "Green" Chemicals;
    - Septic tank friendly chemicals;
  - Cartridge Label Graphics

- Product Packaging:
  - Design of packaging?
    - Transparent "window" to view product?

- Advertising:

- Plan to advertise product?

- Expected Volume Estimate:
  - Product Demand? How many initial units to produce?
  - What should be the initial production capability? Units per day?

- Costs:
  - Cost Estimate per Unit: Hire an engineering company to research the idea to provide feasibility and cost estimates.
  - Product R&D Costs: Hire an R&D engineering company to research and develop the idea into a product that can be manufactured.
  - Production Costs:
    - Plastic Injection Mold Costs: Select a company that can produce quality injection molds;
    - Plastic Injection Costs: Select a company that can produce quality plastic parts;
    - Part Costs: Procure all of the parts required for manufacturing;
    - Manufacturing Costs: Select an assembly/packaging company that can produce high-quality products;
    - Advertising Costs:
    - Distribution/Sales Costs:

- Distribution Channel:
  - Plan on how to distribute this product?

Engineering Research & Design:

1) Product Chassis Issues:

- Clip-On Adjustable Hangar: Designed for ease of installation & fit on variety of toilet tanks; adjustable; The best design would satisfy these requirements:

- Must be adjustable; The bracket must allow the user to lower the unit into the tank for the best location away from obstacles;

- Must be very thin where it curves around the tank's edge, so that it will not interfere with the fit of the tank's lid;

- Should fit a variety of shaped tanks: Some tanks are round or oval; Therefore, the hangar should probably have a two-fingered design so that each "finger" can grip a different spot on the tank's edge and still be able to support the unit.

- Chassis Shape: The chassis must be designed to that all water splash will be able to drain off and not pool. This is especially important where there is a space between the cartridge and the chassis.

    - R&D: Determine statistics on toilet tanks: How many ball types, how much space between the water level and the top of the tank.

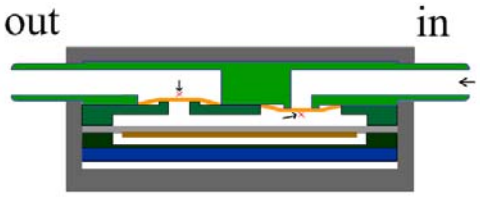
- Waterproof Buttons: Two tactile or membrane buttons can be used to select the liquid concentration level; this will allow a user to select the sanitizer concentration. Each push of the button would activate a piezoelectric buzzer as feedback. There could be 10 or more levels of concentration. The buzzer could get louder and louder with each button push as a signal; also, several seconds after releasing the button, the beeper could beep the number of times 1-10 to indicate the exact level of concentration that was selected. A soft, sealed membrane with button illustrations such as those below would allow a user to push the buttons behind the film that are mounted onto the computer circuit board;

- Inlet Port: Will simply be a small tube that protrudes into the cartridge compartment; Once the cartridge is inserted into the compartment, the inlet port becomes inserted into the valve mechanism inside the cartridge, thereby opening the valve;

- Outlet Port: Will simply be a small tube that protrudes from the bottom of the unit. It will reside inside a small concave indentation so that the unit will sit flat without the outlet tube touching anything. This would consist of a small convex or hemisphere indentation on the bottom surface of the unit with a tiny tube protruding from within. This protruding tube inside this cavity will allow drops to form and fall without a mess;

2) Liquid Pump Issues:

- Liquid Pump Type: Liquid Pump: A piezoelectric micro liquid pump will probably be the best cost effective solution. The pump is just a couple of membranes that vibrate with a piezoelectric vibrator. The Liqua-Flush chassis itself could form the shell of the pump whereby only the pump's "plates" would need to be glued into place. All of the liquid passageways for the liquid from the cartridge actuator through the pump and toilet tank outlet are formed into the plastic shell of the product. Once the two halves of the shell are "fused" together, a complete liquid duct would be formed. This would save the cost of tubing and assemblage cost.



- Can easily pump various viscosities of sanitizing solution;
- Can work well in a wide range of temperatures;
- Manufactured to have a very long life;
- Corrosion free with various types of very harsh acidic sanitizing solution;

3) Battery Issues:

- Able supply power for at least a year; Calculate power requirements: 4 @ AAA batteries?
- Battery Compartment Cover: The cover must use a waterproof "O-ring" design since water can splash onto the unit; Many products use this waterproofing method, such as the S.C. Johnson "Scrubbing Bubbles Shower Cleaner" product (illustrated below); the contacts come with a dab of silicone grease to help prevent corrosion.



4) Water Level Sensor Issues:

- Consume low power so that battery life will last at least a year;

- Accurately measure the water level of the tank;

- Still work if any water is splashed onto the sensor; (the sensors could be located away from the chassis' bottom surface to minimize the potential of water splash); (i.e. inside of a tube);

5) Audio Feedback:

- Piezoelectric Buzzer can be used to signal concentration level, low battery condition and possibly low fluid level;

6) Cartridge Issues:

- Valve Design: The best and least expensive way to design the cartridge valve system is to use "tensioned plastic". A flap of plastic that is formed with the cartridge will hold tension against an outlet port. Once an actuator is inserted into the outlet port, it will push open this plastic valve to allow the flow of liquid; The chassis actuator is simply a hollow tube that is responsible for engaging and opening the cartridge valve and to duct the liquid into the chassis. A small amount of felt-like material could be used just inside the actuator and cartridge port to prevent leakage once the cartridge is removed;

- Valve Leakage: Must be designed for no leaks;

    - A seal and or cap can prevent any solution leaking from the cartridge during storage & transit; Once the seal is removed, a tensioned valve inside the cartridge should prevent leakage while the cartridge is installed or removed from Liqua-Flush body;

    - A small felt-like mesh (a permeable barrier) could be installed inside the cartridge and chassis orifices to further prevent leakage (i.e. to prevent drops that could discharge while the cartridge is being changed);

- Ventilation: What is the best solution to ventilate the cartridge?

    - Ventilation Orifice? A ventilation valve could be used that would allow air to enter the cartridge as the liquid is consumed. The valve could be located at the upper end of the cartridge above the drain valve; This would be a good location because a single seal could be used to cover both orifices. A user would only have to pull off one seal to utilize the cartridge.

- No Ventilation Orifice?
    - Combination Valve? The actuator that draws liquid from the cartridge could be designed so that it can also ventilate the cartridge as well as draw fluid from it. S.C. Johnson "Scrubbing Bubbles Shower Cleaner" product ventilates the bottle from a single tube.

    - Plastic bladder design? The cartridge can use a plastic bag to hold the sanitizing solution. That way, the cartridge shell that it resides in is simply vented with air holes to the environment. No pressure vents would be needed and gas expansion/contraction with temperature would no longer be an issue. One side of the bag would be fused onto the valve assembly. However, this solution may cost more and waste too much product.

- Volume of cartridge to last at least 3 months? How much solution per flush? How many flushes on average per day?

7) Sanitizing Solution:

- Characteristics of Sanitizing/Disinfectant Solution:
    - Disinfectants are antimicrobial agents that are applied to objects to destroy microorganisms that are living on the objects.
    - Sanitizers are substances that simultaneously clean and disinfect.
- Chemicals Used with Toilet Sanitizing Solution: Research of common or industry standard chemicals:
    - Hydrochloric Acid: is an active ingredient in many toilet bowl cleaners, such as;
        - Diversey VANISH Thick Liquid Disinfectant Bowl Cleaner
        - Diversey Crew Heavy Duty Toilet Bowl Cleaner
        - Diversey Crew Mean Green Toilet Bowl Cleaner
    - Oxalic Acid

        - Diversey Crew Super Blue Mild Acid Bowl Cleaner

    - Alkyl Dimethyl Ethyl Benzyl Ammonium Chloride;

        - Diversey VANISH Non-Acid Bowl & Bathroom Cleaner II
        - Diversey Crew Clinging Toilet Bowl Cleaner

    - Alkyl Polyglucoside;

        - Clorox Greenworks Natural Bowl Cleaner

    - Sodium Hypochloride, Sodium Cocoate, Sodium Hydroxide, Myristamine Oxide, Lauramine Oxide;

        - Clorox Toilet Bowl Cleaner with Bleach

    - Sodium Citrate (Trisodium Citrate); (is used in laundry and hard surface cleaners to help remove soap scum and stains, and to help regulate the pH of the product); Acrylic Copolymer (bind minerals such as calcium and magnesium -known as water hardness-, enabling a cleaning product to remove hard water stains);

        - http://householdproducts.nlm.nih.gov/cgi-bin/household/brands?tbl=chem&id=37&query=Sodium+Citrate&searchas=TblChemicals

        - Clorox Blue Toilet Bowl Cleaner

    - Sodium Percarbonate (Peroxydicarbonic Acid) (Disodium Peroxydicarbonate);

        - http://householdproducts.nlm.nih.gov/cgi-bin/household/brands?tbl=chem&id=2536&query=Sodium+Percarbonate&searchas=TblChemicals

        - Clorox Bleach & Blue Automatic Toilet Cleaner – Tablet

    - Hydrogen Peroxide, Benzyl Alcohol, Hydroxyacetic Acid;

        - Diversey Sporicidal Toilet Bowl Cleaner

    - Acid Anionic (Peracetic Acid)

    - Phosphoric Acid

    - Chlorine Bleach

    - Alcohol, Isopropyl Alcohol, Laureth-3, Lauralkonium Choride, Parfum

- Viscosity Issues with Temperature and Age: The solution must be thin enough to flow under a wide range of temperatures; The solution should not “dry out” or age so that it

could clog the system; The solution must have a very long shelf life; The chemicals should never separate over time;

- Amount to be Dispensed: How much solution is necessary for each dispensing cycle; What range from light to heavy;

- Colored Solution Options: Blue: Chemical Name: Acid Blue 9 (C.I. 42090) is a colorant (widely used food dye or pigment) added to cleaning products to improve aesthetic appeal, or to act as a tracer (for example in certain toilet bowl cleaners, blue coloration indicates that the product is working).

    - http://householdproducts.nlm.nih.gov/cgi-bin/household/brands?tbl=chem&id=1633

- Fragrance: Fragrances and perfumes are mixtures of fragrant essential oils, aroma compounds, fixatives and solvents to add a particular scent (lavender, lemon, etc.), and to mask unpleasant odors.

Production:

Scale of Production:

- Outsourcing: To minimize initial product development costs and risks associated with new product adoption, outsourcing almost all of the production would be feasible; Once the product has proven sales, in-house production lines could be established in order to maximize profitability;

Plastic Injection Mold Design:

- Mold Cavity: Once the design elements have been finalized, a plastic injection mold company can design the mold. All of the Liqua-Flush parts are rather small, so a single mold cavity could be designed to produce all of the required parts for one complete unit.

- How Many Mold Cavities? The required number production units/time would determine how many mold cavities to combine so that a single injection could produce multiple units. The size of the equipment needed to run the mold could then be figured. On the conservative side, only one mold cavity would suffice to minimize startup costs:

    - Most molding operations produce parts 24 hours a day, five days a week. Assuming a 52-week year, 5 days a week and 24 hours a day, a total calculated time of 6,240 hours a year is available. That would be 520 hours per month. Example: If a molding machine can produce 100 units / hour, then 52,000 units could be produced from a single mold cavity per month.

Parts Procurement:

- Parts for the initial staging would need to be procured. While this ordering process could be outsourced with the manufacturer, considerable expenses could be saved by sourcing and supplying the manufacturer with the required parts.

Manufacturing, Testing, Quality Assurance & Packaging:

- Assembly Line: The manufacturer would need to set up an assembly line, complete with a high focus on quality control.