Sponsor: Product Care Association

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Introduction

Describe the magnitude and scope of the problem being suggested and make a reasonable estimate of the resources required. Give some background, including the reason(s) the project is needed.

BACKGROUND

Product Care Association (Product Care) is a federally incorporated, not-for-profit product stewardship association formed in response to product stewardship regulations and is governed by a multi sector industry board of directors.

Product Care operates the only product stewardship program for designated leftover post-consumer paint and coatings products, primarily architectural paint, in BC pursuant to a program plan approved under the Recycling Regulation by the BC Ministry of Environment and Climate Change.

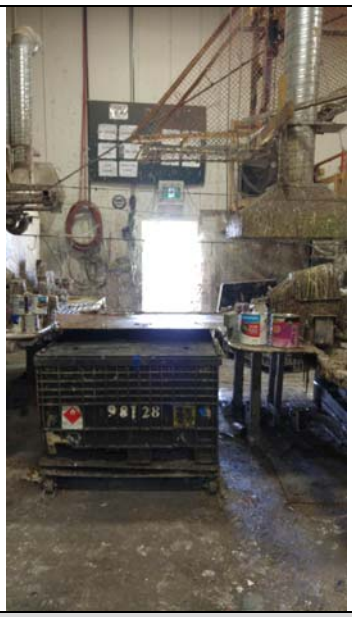
Product Care contracts with 220 collection sites across BC to accept unwanted paint from consumers. The partially full leftover water-based and oil-based paint containers are received at the collection sites in the original paint containers, which are then co-packaged in dedicated collection bins.

The collection bins are transported by contracted service providers to the Delta facility.

PROCESS

At Product Care's Delta facility, trained workers remove each paint container from the collection bins, open the containers and sort them by type, colour and quality in order to apply the appropriate method of management.

A team of 6 employees work at 5 different stations (pictured below); the first two stations are for opening and then sorting paint containers, and then there are 3 processing stations, where the containers are emptied out: oil-based paint, poor-quality, water-based paint, and high-quality, water-based paint.

	
Opening/Sorting	Oil-based Processing
• Containers opened then sorted between oil-based and water-based	• 22% of paint • Liquid and solid paint removal • Automation replaces emptying out the paint manually

	
Water-based Processing (low quality)	Water-based Processing (high quality)
• 29% of paint • Liquid and solid paint removal • Automation replaces emptying out the paint manually	• 49% of paint • Liquid paint removal (no solids) • Automation replaces emptying out the paint manually

Process Line

Workers at the processing stations must empty out the paint cans manually using gravity and 'spatulas', which are used to scoop out paint (pictured below).

Spatula

Spatula 'scoops' out paint

High quality, water-based paint is sorted into 12 different colours. Currently they are emptied through screens, into drums, which are then pumped into 1000 litre totes. The full totes are sent for recycling as paint. Other than large debris screens, there is no further treatment to the paint.

OTHER PROJECT DETAILS

All paint commonly comes in in container sizes of 1 litre (1 quart), 4 litres (1 gallon) and 20 litres (5 gallon). The majority of paint is in 4 litre containers. In addition, to size, the containers come in different materials, as well as integrity. Oil-based paint comes in metal containers, whereas water-based paint will come in metal, plastic or metal-

plastic hybrid (plastic body, metal rim) containers. The container condition and integrity may vary due to how the can was stored; metal containers may be rusty or dented.

The break-down of paint type and quality, is as follows: 22% is oil-based paint, 29% is poor-quality, water-based paint, and 49% is high-quality, water-based paint. Oil-based paint is considered combustible, thus any equipment processing it, must be appropriately designed to manage the fire risk (no electrical, or explosion proof). Approximately 78% of paint is water-based, with no toxicity or flammable risk.

Given the above break-down of container size and paint type, any systems or equipment developed should focus on emptying water-based paint in 4 litre cans. However, ideally, any system or equipment developed would be used for all paint types and container sizes.

Paint is leftover from consumers, and may be sitting for years, as a result, the viscosity of the paint can vary dramatically. Further to this, over time, paint will stratify, with lighter liquids sitting on top, and the heavier solids accumulating on the bottom of the container. Some poor quality paint and oil-based paint may contain solid, polymerized material. Product Care has a separate, manual system for removing this material; the project team does not have to create a system that handles the solid material, but does need to be aware of its presence.

It is estimated that the team working on this project will require funding to purchase material or equipment for creating prototypes. Most of the work involved will be the determining options for emptying the containers, and designing systems that will be testable in the current environment.

Brief Project Description

Please explain the problem to be solved, refer to prior work conducted by the customer or others, and describe any constraints not included below.

The method of emptying out containers manually requires significant man-hours, and due to the technique required, workers are prone to repetitive wrist injuries. A faster, safer, less labour intensive method for emptying out containers of paint is needed to increase the number paint containers emptied, while requiring fewer man-hours and ensuring the containers are clean enough for metal recycling. The paint containers do not need to be washed and may contain a thin film of paint left in

them. Essentially, automation will replace the need to empty paint from containers using spatula's.

The project team will need to consider the following factors:

- Speed for emptying out cans
    - Must meet or exceed the current method (approximately 11 seconds to empty a 4 litre paint can), taking into account the varying viscosity of the leftover paint
- The can must have minimal residue
    - The can must be reasonably emptied of residue paint so that it can be recycled
- Sustained operation
    - Product Care processing operates 24 hrs; the equipment would need to be able to operate constantly
- Safety
    - The new system must be safer than the current method
- Equipment maintenance
    - Paint intrusion on moving parts or electrical parts
    - Availability of any replaceable or disposable parts
    - Reliable, and able to go long stretches without maintenance and/or require minimal preventative maintenance
- System expansion
    - System must be able to be able to be scalable to increase production capacity
    - The system must fit in an environment with limited space
    - The system must work for multiple types and colours of paint without cross contamination, or be duplicated for each type, while fitting in a similar footprint
- Costs to create the system and equipment
    - The system must be built on a budget suitable to Product Care
    - Ongoing equipment maintenance costs must be factored into overall system costs
- Container size restrictions
    - The system must handle the 4 litre containers
    - Flexibility to empty out the other sizes is ideal
- Fire risk

    - The majority of containers handled are water-based paint, and present no risk of fire
    - 33% by volume of containers contain oil-based paint, ideally the system designed should be able to be used for oil-based paint, a combustible liquid

Product Care has performed some research and development in this area. Some concepts that have been tested:

- Pneumatic spinning spatula
    - The spatula attachment was not able to effectively remove enough paint residue
- Vacuum system
    - The vacuum took too long to empty the can; the suction was too weak
    - Product Care did not feel the system was proven enough to warrant significant investment in a more powerful vacuum
    - A vacuum system has been tested by Akzo Nobel, but did not meet all the requirements. An article and video of this is available, at the link below: https://www.youtube.com/watch?v=VMPWcPb1Ui8&feature=youtu.be
    - Product Care also has more confidential project details regarding this intitiative

A specification sheet is available that provides current emptying times by container size, overall cans emptied per shift by container type, and viscosity.

Expected Outcomes

What is expected at project completion. prototypes, mock-ups, beta units of systems, a demonstration, a series of conceptual designs. If possible, list important milestones that could be used to track progress.

It is expected that the team will produce a working prototype that can be demonstrated in the existing process area. With this prototype will be a list of the required supplies for its creation, designs and specifications necessary to fabricate an additional prototype, and instructions on its use, and maintenance.

Critical milestones include:

- Development of one or more concepts for the system
- Proof of one or more concepts in theory based on calculations, virtual models, simulations, and/or other similar methods

- Selection of the ideal concept based on the previous exercises that are most likely to deliver a system that meets Product Care's needs
- Fabrication and assembly of a prototype for the proposed system
- Testing of the prototype in a real world environment
- Final model created with all the necessary instructions, specifications and other details for its reproduction, ongoing maintenance, and repair

Resources Available from the Customer

Please list financial, supervisory or other in kind support that will be made available to the team. Note: these may be contingent on how well the students progress through the project.

Product Care will make available its facility for development and testing, its maintenance and management staff for consultation, and a budget of $5k for the purchase of supplies and equipment necessary to fabricate a prototype. Any purchases would need to be authorized through Product Care management.

In addition, due to the prospect of restricted site visits and use of the University shop, Product Care will make available its maintenance staff to assemble prototypes for testing, if provided a list of parts and assembly instructions. Also, Product Care can perform minor fabrication, and has industry contacts for various fabrication and machine shop services.

Once a testable prototype is created, Product Care will provide its production staff for testing and to provide feedback.

Customer Requirements

Please list in order of importance your requirements (as envisioned at this stage) for the design in terms of functional performance, aesthetic, cost and other considerations that may be specific to the application. Putting the criteria into 2 or three categories of importance (for example: must have, nice, maybe) is a good start. Please be specific by quantifying your requirements whenever possible.

Functional Performance	Must perform better than the existing system: • Faster processing (11 s/can) • Non-manual system • Paint residue removed

	• Sustained 24 hr operation
Footprint	Must fit in existing space and allow for expansion for multiple systems
Maintenance Cost	The time to maintain the system, and the cost of any disposable or wearable components must be balanced with the total system cost Any parts for equipment operation must be readily available
Fabrication Cost	Must be costed in such a way that the labour savings offsets the system cost
Aesthetic	Not required