Project Deliverable F: Prototype I and Customer Feedback

GNG 1103

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March 3, 2024

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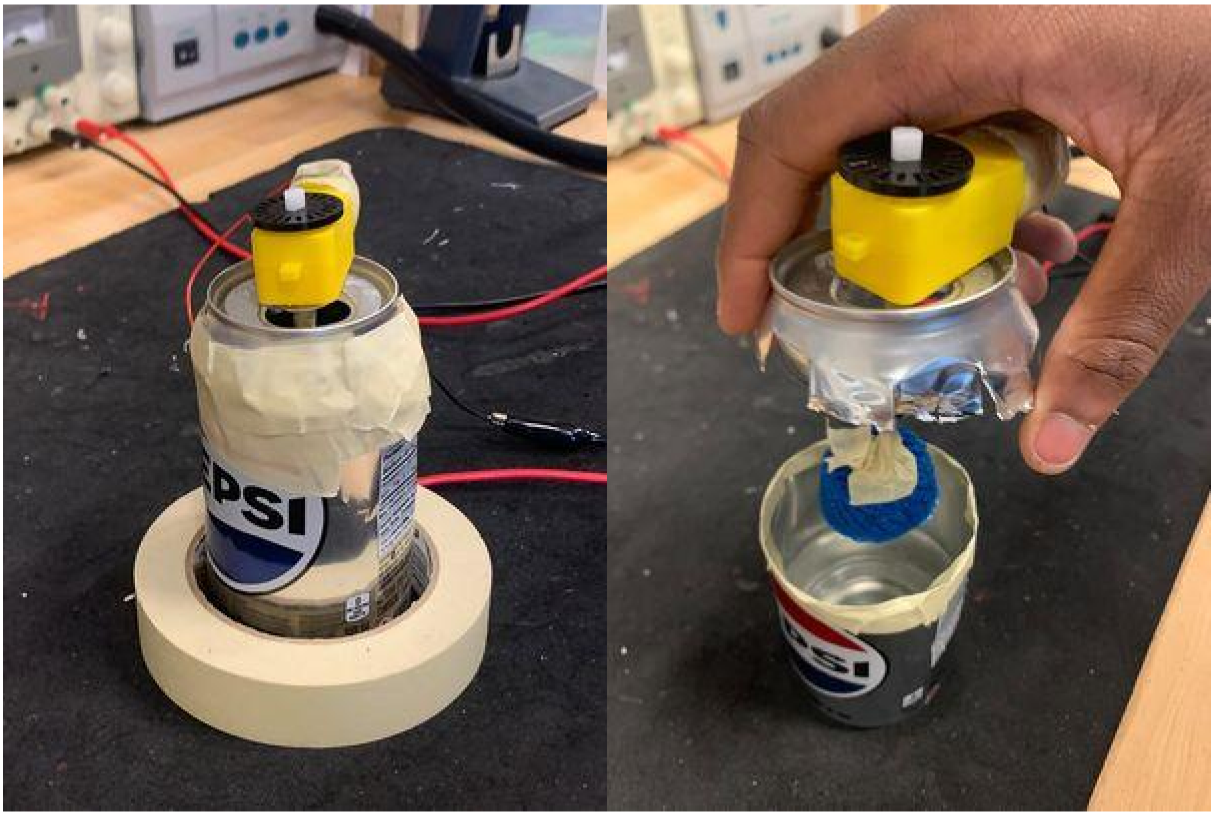
1. Introduction

Canadian Nuclear Laboratories explores various aspects of nuclear science and technology in Canada. They study a variety of materials to help improve design features, however using new material comes with uncertainty and potential challenges. The goal of this project is to help alleviate some of this uncertainty in materials testing by creating a device that can be used to test the degree to which erosion parameters affect a given material/part. This report discusses the first round of testing for the finalised concept. It further gives an updated bill of materials based on the feedback from the project manager on the previous bill of materials.

2. Prototype One



3. Analysis of Critical Components

The overall concept for the erosion testing for this prototype was moving a part in a fluid to simulate the erosion. This method works well since regardless of whether the part os used in an environment where it was stationary with moving fluid or the fluid was stationary and there was a moving part, there relative speed would be the same if the frame of reference was the part; the water would always be moving against the part causing erosion. To facilitate this movement, we employed a motor and a loading apparatus. We combined these together using tape so that any movement of the motor would move the loading apparatus as well as the tested part. The speed of the motor can be varied by varying the voltage given.

Although it is another critical component for the erosion testing device, the fluid was not of any importance with respect to this prototype and testing sequence.

4. Prototyping Test Results

ID	Test Description	Results
1	Leakage	There was no visible leakage.
2	Stability	The motor does fluctuate slightly. However, the container stays stable.
3	Loading capacity	The loading mechanism is undamaged while handling a small and light sample (<20g).
4	Loading capability	The loading mechanism can visibly withstand low RPM and low viscosity (tap water).
5	Software	Software was not used for this prototype.

5. Feedback and Comments

- The motor could be held in place with a rigid structure.
- The shaft could be in the centre and it might be nice to have a way to know what depth the sample is sitting at.
- Using a metal can was a great idea.

6. Updated Target Specifications & BOM

6. 1. Target Specifications

Specifications	Updated	Prototype I
Minimum Size	RADIUS: 8.5cm HEIGHT: 20cm	RADIUS: 3.3cm HEIGHT: 12.2cm
Maximum Weight (dry)	5 kg	17g (Can) + Motor + Sample
Rotating Speed (constant)	1500 rpm	50 rpm
Maximum Fluid Temperature	30^0C	25^0C
Maximum Size of Abrasives	2mm	1.5mm

(diameter)		
Maximum Pressure of The System	1 atm	1 atm
Data Collecting Instruments	YES	N/A
Ability to Test Multiple Samples	YES	YES

6. 2. Bill of Materials

Erosion Testing Device Budget					
BUDGETED AMOUNT	TOTAL COSTS	DIFFERENCE			
$100.00	**$131.00**	**-$31.00**			
Description	**Material**	**Type**	**QUANTITY**	**COST**	**TOTAL**
Paint Container **[1]**	Metal (aluminum)	Container/Housing	1	$7.99	$7.99
Motor **[2]**	Metal	Torque Mechanism	1	$34.39	$34.39
Threaded Shaft **[3]**	Metal	Loading/Shaft	1	$11.27	$11.27
CaOH **[4]**	Calcium Hydroxide	Abrasives	1	$16.50	$16.50
Adapter **[5]**	Electronics	Power Supply		$19.19	$19.19
Shaft Coupling **[9]**	Aluminum	Shaft Connection	2	$4.80	$9.60
Nuts **[6]**	Metal	Material Security	4	$0.27	$1.08
Washers **[7]**	Metal		4	$0.16	$0.64
Arduino UNO R3 **[8]**	Electronics	Electronic Hardware	1	$15.25	$15.25
SUB TOTAL					**$15.91**
TOTAL					**$131.00**

7. Prototype Two Test Plan

ID	Objective	Test and Description	Results to Collect	Duration
1	Leakage: As leakage is unpleasant and could damage electronics, this test checks whether the basic design could	- Prototype 2 with tap water (lowest viscosity) - Check for leakage while the device has water but is not working - Check for leakage	- Specific leaking origin on the device → reinforce that specific part - Volume of leaked fluid → Visualization	- Duration: Less than one day - Start date: - Dependencies: Functional final version of Prototype 2

	lead to leakage and if yes, at which amount	while the device is working at designated RPM - Find the volume of leakage in both cases by measuring the volume of water in the container before and after the process - Locate where the leakage originated	of how severe the leakage is → Might consider a different design	
2	Stability: As the working motor could create considerable vibration and fluctuation, this test checks whether the design is stable enough	- Prototype 2 with different types of fluid (ascending viscosity) - Let the motor work with each type of fluid, under designated RPMs - Note for each scenario whether the device: slightly vibrates, moderately fluctuates, severely fluctuates or totally collapses	- Scenarios where the device severely fluctuates or totally collapses → reinforce the base or consider a different design	- Duration: Less than one day - Start date: - Dependencies: Functional final version of Prototype 2
3	Loading capacity: This checks for the maximum possible weight of sample the loading mechanism (motor and attached rod) can support	- Prototype 2 with different types of sample (ascending weight) - Let the device work for each scenario - Note for each scenario whether the loading mechanism is: 'worked & undamaged' or 'can not function / damaged'	- Scenarios where the loading mechanism is damaged → reinforce the loading mechanism or consider a different design	- Duration: Less than one day - Start date: - Dependencies: Functional final version of Prototype 2
4	Loading capability: This checks for the maximum viscosity of fluid the loading mechanism (motor and attached rod) can support	- Prototype 2 with different types of fluid (ascending viscosity) - Let the device work for each scenario - Note for each scenario whether the loading mechanism is: 'worked & undamaged' or 'can not function / damaged'	- Scenarios where the loading mechanism is damaged → reinforce the loading mechanism or consider a different design/motor	- Duration: Less than one day - Start date: - Dependencies: Functional final version of Prototype 2
5	Software: This checks whether the chosen motor, programming language and accompanying electronics work well together	- Prototype 2 with accompanying electronics and software - Connect the motor and other electronics to a personal laptop → run the program - Check whether the motor works as planned	- Scenario when the motor does not work as planned → Fix the code / choose different programming language and accompanying electronics	- Duration: Less than one day - Start date: - Dependencies: Functional final version of Prototype 2

8. Conclusion

Canadian Nuclear Laboratories explores various aspects of nuclear science and technology in Canada. They study a variety of materials to help improve design features, however using new material comes with uncertainty and potential challenges. The finalised concept has been tested with a rough prototype and all the tests were successful. The current concept works well thus far and no major changes will be made in the making of the next prototype for the next rounds of tests. The bill of materials has been updated with a new motor and an adapter. With these modifications, we hope that the next rounds of testing will run smoothly.

9. References

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