Project Deliverable G: Prototype II and Customer Feedback

GNG 1103

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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 second 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 and the accessibility of materials.

2. Prototype Two

The second round of testing focused on the motor subsystem. The final motor was too big to be contained by any part that we had so far so we decided to opt for a motor-only subsystem since it allowed for all the tests we intended to carry out. We wanted to test the controllability of the motor and the power supplied to the motor.

3. Analytical Model

As a group, we are focusing on abrasive size, viscosity (concentration of abrasives) and its relation to erosion. For creating a mathematical model, we will be making some assumptions.

1. The fluid is a suspension of additive particles.
2. The particles are all the same size.
3. The solvent does not contribute to erosion.
4. The parameters identified are functions of a linear system.

s = Particle size
v = Concentration of particles
t = time for which experiment is tested for

K_u = Erosion constant

U^m = unknown parameters directly proportional

U^n = unknown parameters inversely proportional

With our initial testing of the prototype, we were able to justify that erosion is a function of t, s and v. We assume that the relation is directly proportional and linear, and all other parameters of erosion are included in U^m and U^n.

Therefore, we have,

1. Erosion $\propto$ s
2. Erosion $\propto$ v
3. Erosion $\propto$ t
4. Erosion $\propto$ U^m
5. Erosion $\propto$ $1 / U^n$

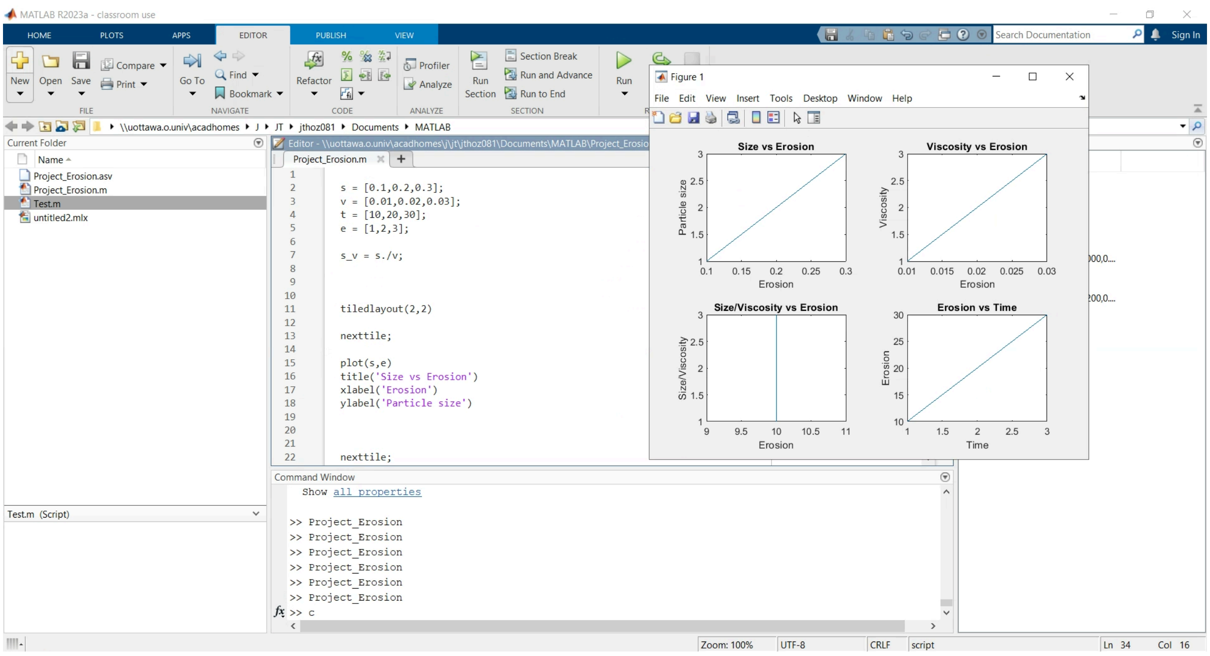
By rules of proportionality, we conclude that,

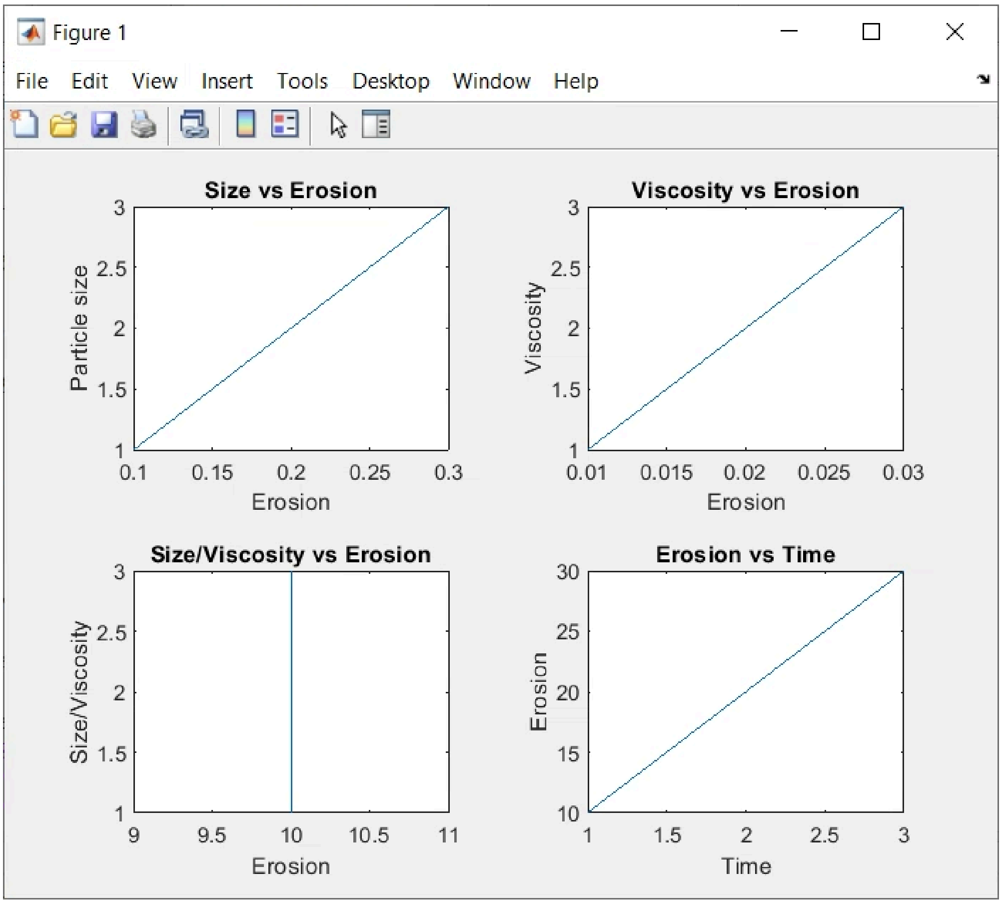
$$\textbf{Erosion} \propto (s)(v)(t)(U^m)/(U^n)$$

That implies, erosion is scaled by a factor of K_u for different materials suspended in solution.

$$\textbf{Erosion} = K_u (s)(v)(t)(U^m)/(U^n)$$

The MatLab model is used for this prediction. We will update the values on actual test results to determine accurate insights into erosion.





4. Prototyping Test Results

ID	Test Description	Results
1	Motor's power source	- The motor works well when connected, through the adapter, to an ordinary electricity outlet
2	Motor's controllability	- The power provided for the motor is controllable by using the adapter - The speed is able to be controlled and predicted reliably. An increase in the volts delivered to the motor resulted in an increase in the angular speed of the motor shaft.

5. Feedback and Comments

- What esthetics, if any, will take place?
- Using the adapter instead of an arduino UNO is an excellent idea.
- How well do you think this prototype will work with other subsystems?

6. Updated Target Specifications & BOM

6. 1. Target Specifications

Specifications	Updated
Minimum Size	RADIUS: 8.5cm HEIGHT: 20cm
Maximum Weight (dry)	8kg
Rotating Speed (constant)	1500 rpm
Maximum Fluid Temperature	30^0C
Maximum Size of Abrasives (diameter)	2mm
Maximum Pressure of The System	1 atm
Data Collecting Instruments	YES
Ability to Test Multiple Samples	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	$36.67	$36.67
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 **[8]**	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
MDF**[9]**	MDF	Insulator	1	$3.50	$3.50
SUB TOTAL					**$106.44**
TOTAL					**$120.27**

7. Prototype Three Test Plan

ID	Objective	Test and Description	Results to Collect	Duration
1	Stability	- Stability test by using the device at different configurations 1. Full motor speed 2. Max and min water level 3. Max and min sample size 4, Recommended water level and sample size.	Overall stability of the system, no hazardous movements.	Duration: Less than one day: - Dependencies: Functional final version of Prototype 3
2	Electrical leakage	- Electrical leakage test by using a multimeter. Since the container is made of metal, we would not like to have current leaking to the container causing risk of eclectic shock. 1. Use a multimeter to verify insulators are doing its job.	Multimeter readings showing no current on the container.	Duration: Less than one day: - Dependencies: Functional final version of Prototype 2
3	Analytical Reliability	Testing the reproducibility of the result that the device produces. 1. Run a sample in the erosion testing device 2. Run two more samples 3. Determine the similarity of the results by using finding the standard deviation	The mass of material that has been eroded is determined by finding the difference in mass before and after the part has been put in the device.	Duration: 2-3 hours

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 in the first round of testing and all the tests were successful. The motor subsystem has been tested in the most recent round of testing and all the tests were successfully carried out. The motor subsystem meets all the requirements: it is robust, and it is capable of providing predictable and variable speed. The bill of materials has been updated to remove the Arduino Uno and driver board amongst other items because they are no longer necessary. With these modifications, we hope that the next rounds of testing will run smoothly.

9. References

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