Project Deliverable B: **Need Identification and Problem Statement** GNG 1103 – Engineering Design

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PROBLEM STATEMENT:

The client needs a reliable material erosion testing system, which is safe, easy to operate, cost efficient and able to test different low stress materials. It must also be able to test the sample quickly in an ambient environment.

Client Alysa Eywindson

1: System, What and Why (client preferences and needs)

The Client wants a dedicated system to test out abrasion factors.

- *The latent factor behind this is to understand the lifetime expectancy of various parts, components, materials, and manufacturing techniques.*
- *Another point to consider is the need to understand the lifecycle of the tested item and its degradation process.*

A pump seal degradation was tried previously and lowered in performance a year and a half later.

- *Erosion product damaged the seal*
- *Work on not the highest speeds (it is dangerous and can be detrimental)*
- *Need a way to assess the rate of erosion over a shorter period of time.*
- *Basis(1000 hour testing)*

The new desired system has to:

- *Time turnaround: 1-2 weeks*
- *Be more flexible*
- *(Preferred) test various materials*
- *Use the energy sector (could be a turbine)*
- *Be repeatable*
- *Can be built and used inside the lab*
- *Use long lasting materials*
- *Circular and use water under 40ºC*
- *Solidity build*
- *Be durable*

2: Test Factors; more test factors allow more data to be generated

The system will be used in a dedicated lab environment by researchers and engineers so:

- *These tests will aim to verify abrasion theories and isolate abrasive variables.*

- *Some suggested abrasive factors to look into:*
  - *Deformation from heat or cold*
  - *Chemical reactions*
  - *Operating times*
  - *Higher energy inputs*
  - *Abrasive content in fluids*
  - *Viscosity of the fluid used*
- *Suggested part factors to look into:*
  - *Diameter/size*
  - *Material*
  - *Density*
  - *Pressure*
- *Test over fluid speed*
- *Test over different energies*
- *Test over different materials (but test with water)*
- *Work at ambient conditions*
- *Submit to harsher conditions (vary rpm)*
- *Procure fatigue behavior*

3: Safety; system should be safe to operate

- *Procure no noise constraint*
- *The system must not be pressurized.*
- *The system must not use overly hot or cold substances.*
- *The system must not use harsh chemicals.Don't go with hot liquid*
- *Don't go with corrosive liquid*
- *Consider the amount of energy inside the system as to not cause dangers*

PRIORITIZE SAFETY, reduce all possible risks

4: Cost; client does not want more than one system per lab

- *The system itself should be safe to operate and built of widely available resources.*
- *We should use easily found items for abrasive tests.*
- *Should have repeatable tests*
- *Use cost-effective materials (budget provided in course)*
- *Choose materials strategically*

5: Data/Results (3: The client values accurate, verifiable, and actionable data.)

Data to be collected:

- *The resulting data (should?) be repeatable and measurable.*
- *How to measure the amount of erosion*
- *Before and after sample weight (can use pictures)*
- *Weight of the particles that come off the sample core as degradates (worn out)*
- *Record the conditions of the erosion*
- *Gatherance of results Ideally automatic (although it could be manual)*

We need to develop a theory regarding how different factors in our system affect erosion
Plan and evaluate the theory
Show results, demonstrate the theory is correct regarding erosion

//Benchmarking used for some needs references//

The device can use the traction of materials to handle erosion
Create sediments and use them
Use rotations and vary water (or fluid) speed
Stress material
Use not orthodox shaped materials (with holes, corners)
Use high temperatures ///For this project it would be dangerous (not safe)
Use some stimulants (sand, rocks, gravel)
Cohesive solids

Tian, H. (2007). A new impact erosion testing setup through Coriolis approach. ELSEVIER. https://www.sciencedirect.com/science/article/abs/pii/S0043164807004024

Ke, L. (2014). Triaxial Erosion Test for Evaluation of Mechanical Consequences of Internal Erosion. ASME. https://asmedigitalcollection.asme.org/geotechnicaltesting/article-abstract/37/2/347/1176730/Triaxial-Erosion-Test-for-Evaluation-of-Mechanical?redirectedFrom=fulltext