University of Ottawa

GNG 1103 – B05: Engineering Design

Project Deliverable C: Design Criteria and Target Specification

Group Members:

Ali Gohar (0300126709)

Gilles Tang (0300245093)

Evan Aguiar-Winter (0300227942)

Aidan Charette (300305703)

James Sutton (300293029)

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1. Introduction

In this deliverable, we will be focusing on the functionality of our product based on the client needs discussed in deliverable B. By visualizing the functional and non-functional needs of the product, we will be able to sort the list with the most important design criteria being the priority, which in turn will allow us to complete technical benchmarking. Both those aspects are required for us to determine target specifications to conceptualize the final solution.

2. Needs and Design Criteria

Table 1.0: Needs Statement, Design Criterion, Functional/Non-Functional Needs

Importance (5>1)	Need	Design Criteria	Functional or non-functional
5	Automatically measure specific gravity	Doesn't require manual measurement	Functional
5	Display Specific Gravity with short intervals	Has a display to show specific gravity real-time or in short intervals	Functional
4	Easy to maintain, longevity	Durable parts that are easily accessible/removable/repairable	Non-Functional
3	Logs time	Keeps track of time	Functional
4	Logs specific gravity	Keeps track of specific gravity	Functional
4	Stores data long term	Able to store all the data collected for as long as required	Functional
5	Measures Accurately	Within Hundredths of g/ml	Functional
4	Inexpensive and simple	Within 15-25k for 16 fermenters retail cost/ $100 budget for prototype	Non-functional
2	Wireless control and data transfer	Able to view and control data wirelessly	Non-functional
3	Ability to graph data in real time or post	Collects and displays data in a graph	Functional
5	Wort stays in closed system	Minimize exposure to contaminates, Prevent tainted data	Functional

3. Benchmarking

Table 2.0: Metrics and Benchmarking Properties

#	Metric	Hanna Instruments	Anton Paar	Mettler Toledo
1	Refractometer	yes	no	no
2	Hydrometer	no	yes	yes
3	Mobility	Handheld	Small Units (Detachable)	Handheld
4	Mass	420 grams	180 grams	355 grams
5	Precision	+ or - 0.3 °C	0.001g/cm3 0.1 °F	0.001g/cm3 0.2 °C
6	Price	C$279.56	C$569.00	Not Given
7	Versatility	methodology from the ICUMSA Methods Book	Specific Gravity, Proof, Plato, Alcohol, Density, KMW, SMV, Babo, Baumé, Brix, Oechsle, Sugar Concentration, Temperature	Specific Gravity, Proof, Plato, Alcohol, Density, KMW, SMV, Babo, Baumé, Brix, Oechsle, Sugar Concentration, Temperature
8	Output method	Screen on the device	Mobile Application	2.4 color screen”
9	Efficiency	2 buttons, easy operating	Extra steps for a more precise reading	Easy test with a dip into the liquid will do
10	Range	0 to 80 °C	41 to 86 °F	-10 to 50 °C
11	Product Dimensions	127 x 127 x 127 mm	101 x 58 x 44 mm	Not Given, but handheld on the pictures

Table 2.1: Comparison of Importance Given by each Measuring Device

#	Metric	Importance 5>1	Hanna Instrument 5>1	Anton Paar 5>1	Mettler Toledo 5>1
1	Refractometer	2	5	1	1
2	Hydrometer	4	1	5	5
3	Mobility	1	4	2	5
4	Weight	1	4	2	5

5	Precision	5	2	5	5
6	Price	3	4	3	1
7	Versatility	3	3	5	5
8	Output method	4	2	5	2
9	Efficiency	4	3	2	5
10	Range	5	4	2	5
11	Product Dimensions	4	3	3	5
Total		36	35	35	44

Therefore, according to the inputs of the table, the product from Mettler Toledo.

3.1. Definitions

- **Specific Gravity:** The ratio of the density of a foreign substance to the density of some substance (In our case pure water.)
- **Refractometer:** An instrument for measuring a refractive index. Used for measuring the concentration of aqueous solutions.
- **Hydrometer:** An instrument used for measuring the density of liquids using the concept of buoyancy.
- **Mobility:** The ability to move freely. Something with high mobility can move with ease.
- **Weight:** The force acting on a mass due to gravity.
- **Precision:** The quality and consistency of accurate results.
- **Price:** The cost of the instrument.
- **Versatility:** How many different measurements can the system of the instrument output.
- **Output Method:** How the user will observe the measurement from the instrument.
- **Efficiency:** The time for the instrument to get the reading.
- **Range:** The Possible temperature that the instrument can handle.

4. Target Specifications

Table 3.0: Functional Requirements

#	Design Specifications	Relation	Value	Units	Importance (5>1)	Verification Method
1	Precision	>	1.01	-	5	testing
2	Log data	=	yes	-	5	testing
3	Update intervals	>	5-10	sec	5	testing
4	Store data	=	-	Excel	5	testing
5	Closed system	=	-	Excel	5	testing
6	Graph data	=	-	Excel	5	testing

Table 3.1: Constraints

#	Design Specifications	Relation	Value	Units	Importance (5>1)	Verification Method
1	Time	>	Nov 20	days	5	-
2	Cost	<	100$	CAD	5	estimate
3	Temperature	=	24	°C	3	testing

Table 3.2: Non-Functional Requirements

#	Design Specifications	Relation	Value	Units	Importance (5>1)	Verification Method
1	Sustainability	>	1	Year	3	Testing
2	Aesthetics	>	-	-	1	Voting
3	Noise	<	70	Decibel	3	Testing

5. Reflection

It is essential for us to speak to the client to establish initial ideas and plans for the project. It allows us to gather information regarding the specifications of the product, functional and non-functional requirements as well as constraints to limit. We were able to ask questions pertaining to exactly what the client is searching for. Thus, placing ourselves in the shoes of the client to better understand the problem at hand. For example, the client explained to us why the float hydrometers weren't a good solution, as they would get lost often. That limits our product from floating freely in the wort. In fact, with this information, we are able to make charts based on the client's needs and requirements. We are also able to identify functional and non-functional requirements through a chart form, which allows us to easily compare and prioritize our constraints. In fact, we decided that the functional requirements are more important than extra features in this design, and the budget is also one of the main concerns to be prioritized. All our constraints are limited by not only the client, but the layout of the course and timeline. Moving forward, more research and benchmarking will allow us to make the most efficient version of the product. Therefore, this deliverable allowed us to visualize and prioritize our future tasks, as well as giving us a better understanding of what is expected from us by this project.

6. Conclusion

Concluding Deliverable C, we were asked to analyze and define our client's needs in a list of prioritized design criteria. In doing so, we established the requirements, conditions, and limitations of every logical outcome for our final product. With these specifications listed, we

were then able to identify and dissect the needs our product must meet, and establish the qualities our product must meet.

7. References

[1] Portable density meter, “Fully Automatic Handheld Density Meter for the Lab or the Field”, Meter Toledo. [Online]. Available: https://www.mt.com/int/en/home/products/Laboratory_Analytics_Browse/density-meter/portable-density-meter.html [Accessed: 09-Oct-2022]

[2] Refractometers, “Hanna Instruments HI 96801 Digital Refractometer, 0-85-Percent Brix Range, for Sugar Analysis”, Amazon. [Online]. Available: https://www.amazon.ca/Instruments-Digital-Refractometer-0-85-Percent-Analysis/dp/B002NX0WHI/ [Accessed: 09-Oct-2022]

[3] Density meter, “EasyDens by Anton Paar - Smart Hydrometer - Digital Density Meter – Determination of extract content, sugar content and alcohol content - Plato, Specific Gravity (SG), Babo, Baumé, Brix, g/L, KMW, Oechsle, ABV, ABW, Proof”, Amazon. [Online]. Available: https://www.amazon.ca/EasyDens-Anton-Paar-Hydrometer-Bluetooth/dp/B099FCDGKT/ [Accessed: 09-Oct-2022]