

## Introduction

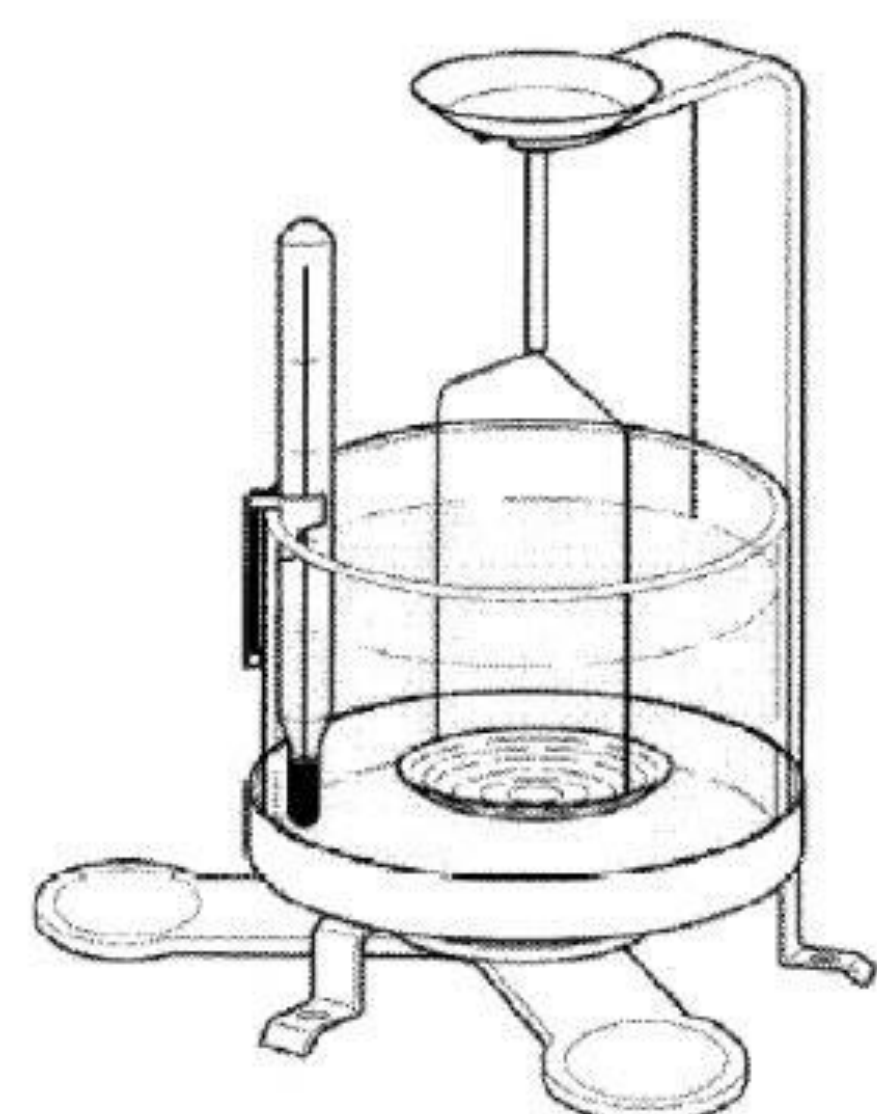
Density is a fundamental physical property of a reinforcement for composites. It appears widely in calculations, which are mostly used for engineering designs.

The density of homogeneous solid materials is generally straightforward to determine, because it requires only measurements of mass (or weight) and of volume of a specimen. Flax fiber requires a different method of density measurement because it is a porous material and possesses unique surface chemistry.

The purpose of this research project is to identify the factors that influence the measurement of density of flax fiber using Buoyancy method.

## Materials

1. A simple density measurement kit for laboratory;
2. Raw flax fiber obtained from University of Saskatchewan, Saskatoon, Canada;
3. Three types of oil: mineral, canola, soybean;
4. Vacuum chamber.



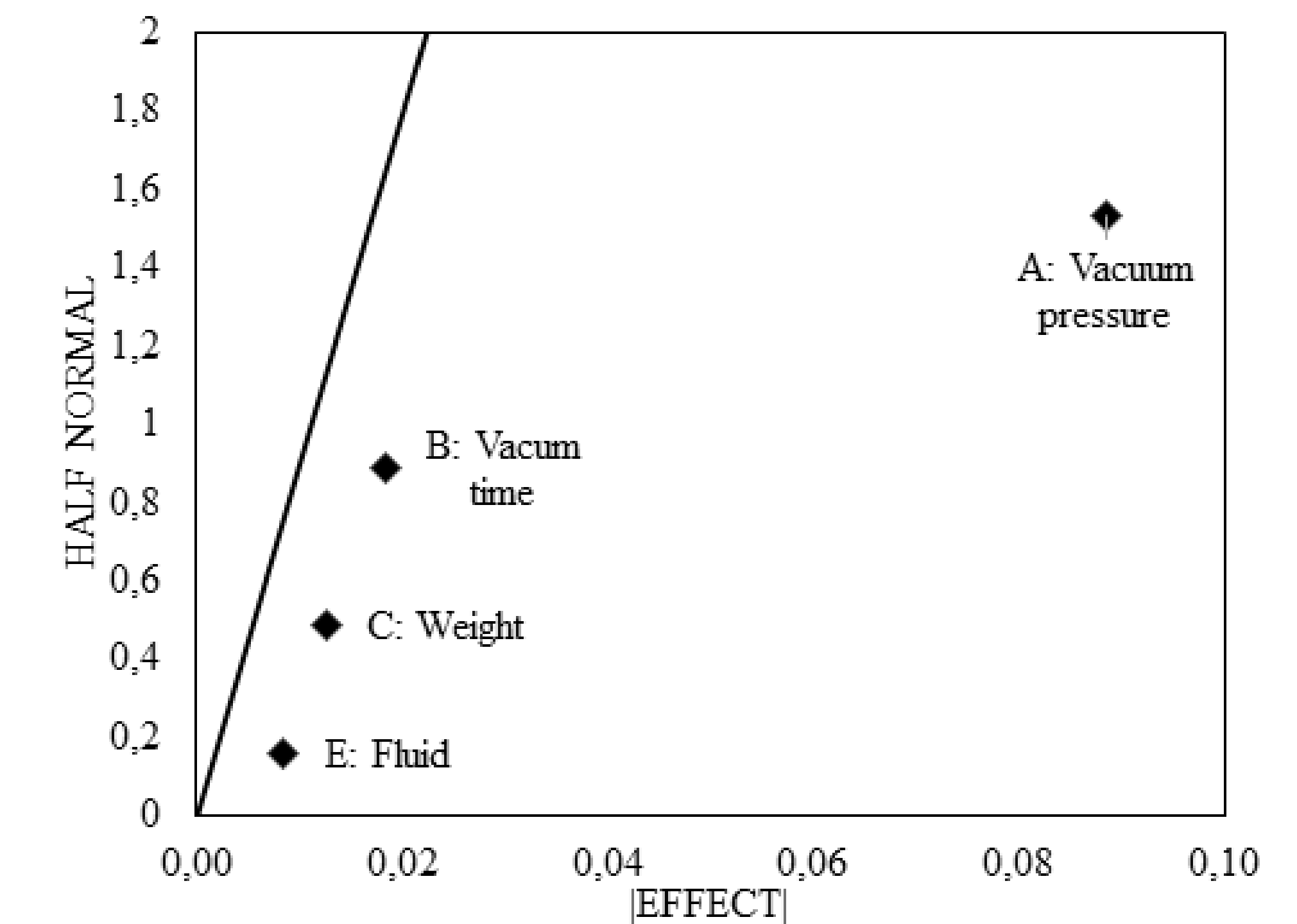
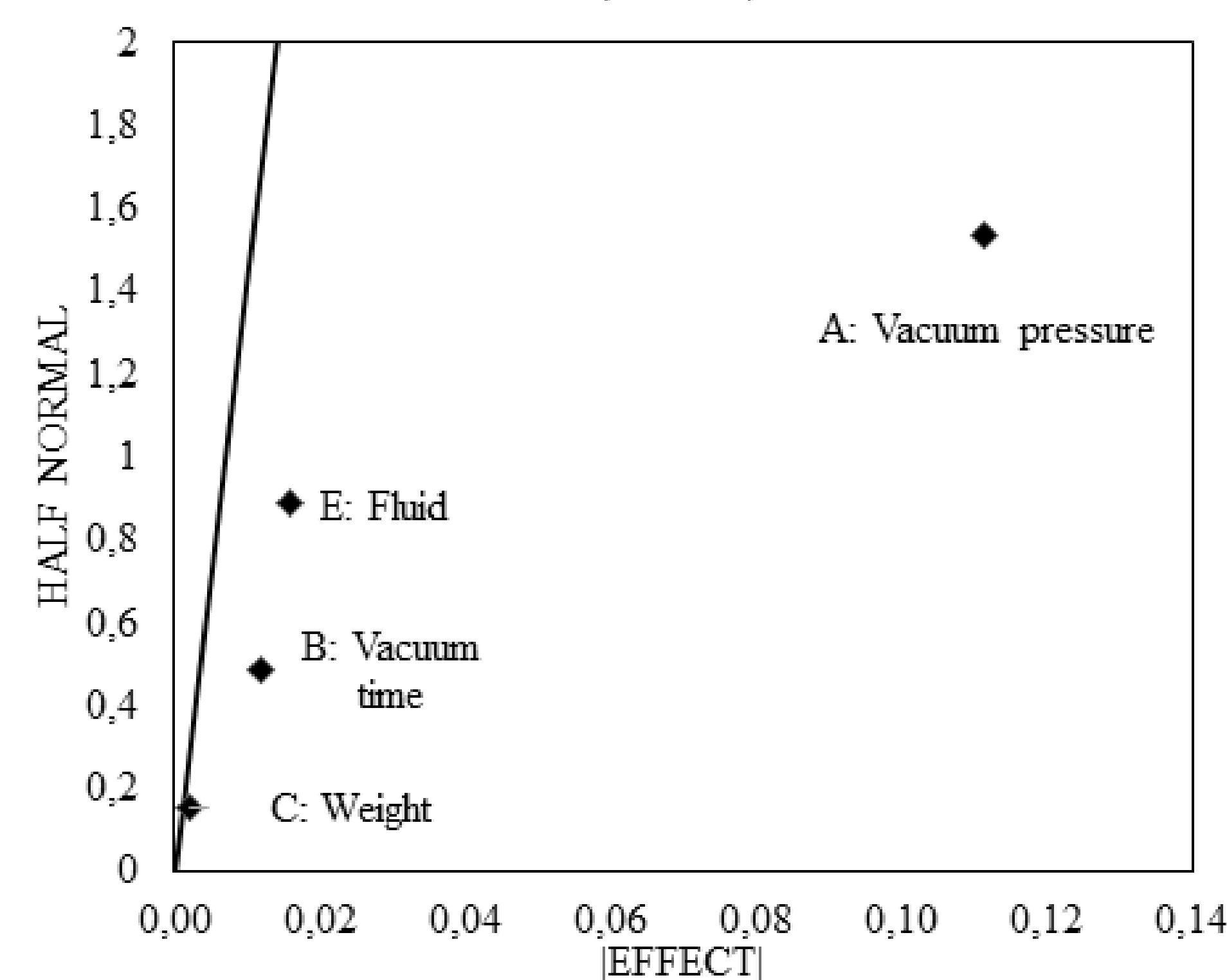
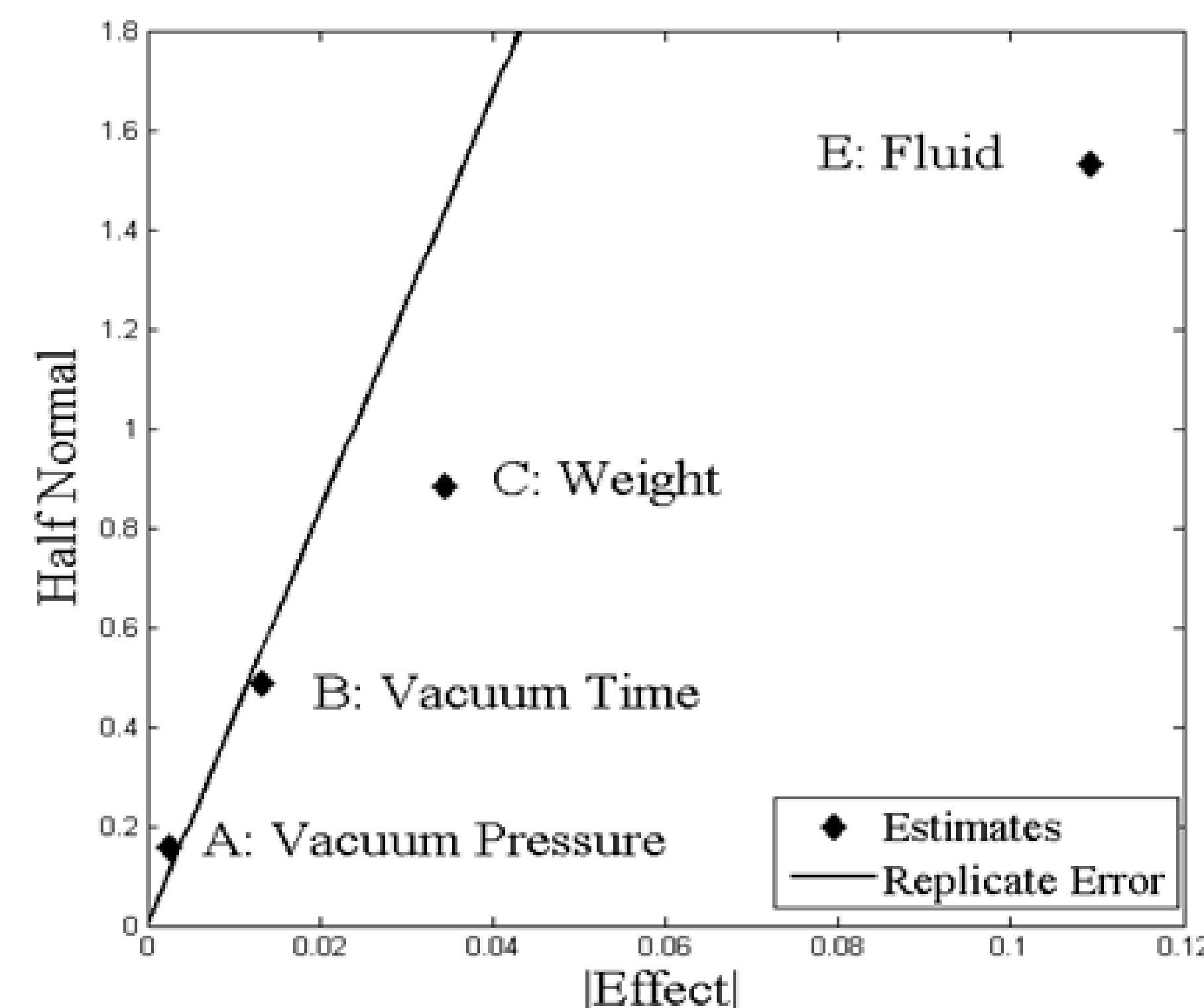
## Methods

The ASTM E1169-14 ruggedness test standard was used for the experiments. Four factors (vacuum pressure, vacuum time, weight and type of fluid) were selected with two levels for each one. For example, the sample weights used for all four experiments were 0.2 and 0.5 grams, which were determined as lower and upper levels.

Vacuum chamber pressure and time ranges were increased for the last two experiments, because air bubbles were still present when low values of those variables were used.

## Results

Half-Normal plots from the three sets of density measurements.



All tests were done at room temperature (around 23 °C).

## Conclusions

From the first test, type of immersion liquid was identified as the largest effect on the results of density measurement for flax fiber.

Results from the second and third ruggedness tests revealed that when the density measurements are taken at higher vacuum pressure, i.e. 50 & 90 kPa compared to 40 & 70 kPa (first test), there is no significant effect from the type of fluid used to conduct the measurements. The effect order for B, C and E (vacuum time, weight and fluid) has changed, but none has a significant effect on the results of density testing.

## Acknowledgements

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