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Setting Conversion with Experimental Validation from Semi Manual to Automatic Hydraulic

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Introduction:

The compacting powder process is increasing daily with the improvement of techniques and technology. A flawless product will be obtained by involving many trials that are expected to cut production time and costs[1].

Different laboratories and production scale machine design for pressing powder inside the cosmetic manufacturer were common practice. It has been challenging when bringing manual laboratories into the automatic production machine setting during the up-scaling process. Pressure and force are important parameters that determine. At the same pressure released, the product can accept different forces, resulting in different qualities using a different machine design. It requires a long time to find and tune the production scale machines.

Pressure and force measurement is quite complex as each machine design has multi-factors that influence it. The compression load cell is an apparatus to convert pressure into an electrical signal in the form of force that can be measured and standardized. Pascal's formula, P=F/A is used to predict the correlation of pressure and force values in each machine.

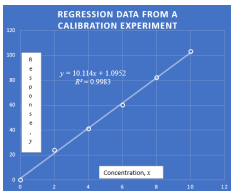
The purpose of this study was to find the setting conversion between pressure and force using an experimental validation. This study would be a guidance for R&D and Engineer in the up-scaling process, and another benefit is decreasing the waste of setting time.

Materials & Methods:

LOAD CELL

Force Measurement on 3 Types of Pressing Machine using Load Cell

3 Types of Pressing Machine used :
1. Semi Manual Hydraulic Powder Press Machine (A)
2. Powder Press Automatic 7 Series 2 Kemwall Machine (B)
3. Powder Press Automatic 6 Series 6 Kemwall Machine (C)



formula A = $\frac{F}{(P*0.070307)}$

Calculation of Surface Area (A)

1. Linearity (R^2)
2. Repeatability (RSD)

$$s = \sum_{i=1}^{n}(x_i - \bar{x})^2 / (n-1)$$

$$\%RSD = \frac{s}{\bar{x}} \cdot 100\%$$

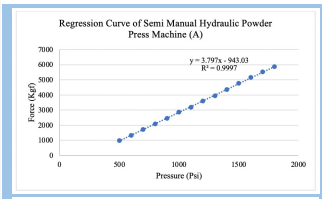
Validation Method Measurement

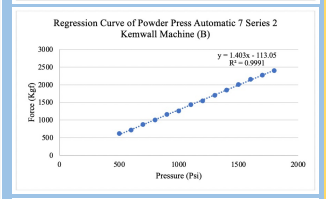
Calculation of the required pressure, using the linear regression equation of each machine.

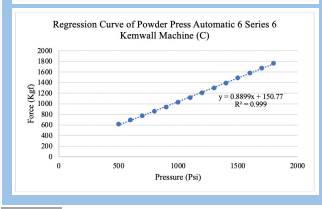
Data Analysis and Conversion Calculation of 3 Types of Pressing Machine

Results & Discussion:

Calibration Curve







The results of force and repeatability measurements on all three machines are shown on the pictures, respectively. The resulting force is linear with the pressure exerted. The higher the pressure, the higher the force value. Meanwhile, the results of the RSD that interpreted the repeatability, obtained a qualified RSD, where the requirement was < 20%. The smaller the RSD value, the more appropriate the method used.

The initial hypothesis of this study is expected to be in line with Pascal's law, but its result is not in line with the law because the A value in the variation of the pressure exerted is not constant. As for the non-constant A value, it is necessary to conduct further research on the influence of the surface area.

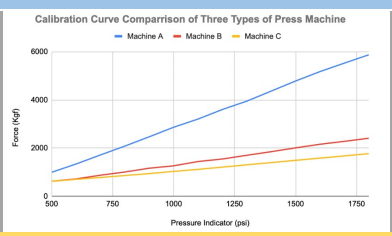


Figure above shows that when the same pressure is released can cause machine A produces a greater force when compared to automatic machines (machine B and machine C). The regression equation of the three machines shows that the value of b as a slope expresses the degree of sensitivity of a method. The slope on machine A, namely 3.8, has a sensitivity of 2.7 times compared to the machine B engine (slope = 1.4), and 4.3 times compared to the machine C engine (slope = 0.88).

Pressure Conversion of Powder Foundation in Three Types of Press Machine

No	Machine Type	Pressure Needed (psi)	Number of Cavity Mold	Force Needed (Kgf)	Force Needed/Cavity (Kgf)
1	Semi Manual Hydraulic Press Machine (A)	1000	4	2864.2	716.1
2	Powder Press Automatic 6 Series 6 Kemwall Machine (B)	591	1	716.1	716.1
3	Powder Press Automatic 7 Series 2 Kemwall Machine	635	1	716.1	716.1

Note: Calculation of the required pressure, using the linear regression equation of each machine.

The compression process is influenced by the number of cavities used. The force received is divided evenly based on the number of cavities used. Semi Manual Hydraulic Press Machine (A) uses four cavities while the other two machines use a single cavity. The compression process with an increasing number of cavities requires a greater force because each cavity must receive the same force. Based on the regression curve generated from data collection, to produce the same force at 716.1 Kgf, the pressure value required for each machine is attached in Table above.

Conclusions:

This paper discusses the basic knowledge related to force measuring instruments and force realization systems. In the future, the converter can be used as a solution to determine which machine to use for up-scaling and production processes that ensure the same force value with the lab scale machine, by entering an existing linear regression equation and to achieve an efficient setting time of the pressing process.

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