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MECHANICAL EFFICIENT FLOUR SIEVE

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Abstract: **Sieving flour is a technique that is traditionally used by both home and professional bakers for separating flour particles of different sizes. A sieve, or sifter, is a device for separating wanted elements from unwanted material or for characterizing the particle size distribution of a sample, typically using a woven screen such as a mesh or net. Normally, it is done by holding the sieve with one hand and tapping the strainer gently with the other. The flour will gradually sift through the strainer. This process is difficult and time-consuming if there is a large amount of flour to sieve. This project aims to develop and introduce an efficient, low-cost, and handy flour sifter for domestic as well as small-scale industrial users to make the sieving process easy. The proposed design is a hand-operated instrument that uses a bevel gear wheel mechanism, and it was found that the developed model has efficiency greater than that of traditional sieving methods.**

Keywords: **Bevel gears, Mesh, Sieve, Sifter**

I. INTRODUCTION

Sieving has been the oldest yet most important unit operation for the industrial and domestic separation of flour particles. The sieve is a tool that has been used for hundreds of years to separate wanted materials from unwanted materials. Though this process is that much older, most people still use the traditional sieve in their homes for this purpose. That is, no instrument has been introduced that meets their needs.

The word "sift" derives from the sieve. Sieving, or sifting, is a simple and convenient technique for separating particles of different sizes. (Project Proposal Report Flour Sieving Machine Team Members: Matrix No, n.d.) A mesh of the sieve is a barrier made of a connected string of metal or other flexible or ductile material.

There are so many kinds of flour sieves made with different materials, such as wood, metal, and plastic, that are available for marketing. It needs to consider screen type, mesh size, and open area to select the screen for the sifter.

Main Objectives

1. Comparing different traditional sieving methods and instruments and identifying problems that might occur with the traditional method
2. To achieve products based on consumer needs by developing the sieve as a hand-operated, more efficient, and energy-saving portable device that can be used both in industry and domestically.

Identifying the Different Types of Flour Sifters That Exist and Their Problems When Using

1. Handheld flour sifters

It is done by holding the sieve with one hand and tapping the strainer.

Figure 1: The traditional process of sifting flour

Disadvantages of Sifting Flour Using Traditional Handheld Flour Sifters

Time-Consuming: Sifting flour is relatively easy for small quantities, but it can become a tedious task when you're working with large batches of dough or batter. For commercial bakers or those preparing food for a crowd, the time spent sifting can become overwhelming.

Flour Waste: Some of the flour can remain trapped in the sieve. Over time, this can lead to a small but noticeable amount of flour waste. This can be a concern when taking accurate weights of ingredients when making food and being frugal in the kitchen. ("Should I sift flour?" Advantages and Disadvantages | the Dough Academy," n.d.) Also, this method is more labor-consuming and requires more people to utilize it for a large amount.

2. Electric flour sifter

It generates high-frequency vibration through an electric vibration device to place flour particles on the screen.

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Figure 2: Electric flour sifter

Due to the effect of vibration, the flour particles will move on the sieve. (Separation Solution: Choose an Electric Flour Sifter, n.d.) These sifters use electricity, so they consume more energy, which leads to increased energy costs for the user. Electric flour shifters are more costly to purchase and maintain for small-scale industries. Also, flour is waste as it remains on the sieve.

3. Squeeze sifter

Squeeze the sifter and squeeze the handle to release the flour through the mesh screen.

Figure 3: Squeeze flour sifter

Bakers with arthritis or hand injuries do not prefer the squeeze sifter because it doesn't require as much hand strength to operate. Also, it is inefficient for larger amounts and therefore cannot be used in industries. (Project Proposal Report Flour Sieving Machine Team Members: Matrix No, n.d.)

4. Semi-Automatic MS Flour Sifter Machine

Figure 4: Semi-automated flour sifter

A semi-automated machine can operate using single-phase current. Has a 3 HP (horsepower) motor. Has 150 kg/hr. of flour sieving capacity. However, the cost of this machine is around ₹36,000 (14151.42 Rs.), which is a high cost. (Flour Sifter Machine, n.d.) Skilled workers are also required to operate the product. Other than that, it also requires a lot of space to install the product.

Apart from these instruments, there are crank shifters used domestically that rotate the crank to rotate the wires that scrape the bottom steel mesh. But the arrangement of wires inside the sieve makes it inefficient. Therefore, our aim of this research project is to make our model more efficient than this.

Factors affecting the efficiency of a sieve

- Nature and the shape of the particles
- Frequency of taping the sieve
- Methods used to prevent sticking or bridging of particles in the apertures of the sieve (flour moisture)
- Tension and physical nature of the sieve material. e.g., nylon or polyester, wire

Other applications of sieves

Sieves are not only used for flour sieving, but various materials can be separated using them.

- Food industry: sugar, salt, alkali, gourmet powder, starch, milk powder, yeast powder, food additive, bean powder, etc.
- Chemical industry: medicine, grease, paint, etc.
- Abrasive material and ceramic industry: building sand, mica, alumina, abrasive, refractory material, slurry, etc.
- Agriculture industry: Tea powder, Fertilizer
- Metallurgy and mining industry: quartz sand, titanium oxide, zinc oxide, etc.
- Mechanical industry: casting sand, powder metallurgy, electromagnetic material and metal powder, etc.

II. METHODOLOGY

- Flow chart of the methodology followed

Data collection and problem identification→Design and material selection→ Material preparation →Fabrication → Testing

The information related to flour sieves was collected by referring to information sources and identifying the traditional methods being used for the sieving process. The processes were observed and identified, as were the issues with those methods and instruments. It could be identified that the process takes much time and is also difficult to continue for a longer time. And also, there were instruments in the bakery industry that cost a lot and required more energy to operate.

The next step was to design an instrument to overcome those problems. With the findings from the literature and experience of traditional methods, it was designed as a

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hand-operated instrument that could be used both domestically and in industry. Fabrication was done using low-cost raw materials and some machines and tools. Finally, testing was done to check the working condition, and then efficiency was calculated according to the performance of the developed instrument.

Material, Machines and Tools

- Material: - Stainless Steel Sieve (Diameter - 20 cm), Stainless steel blade, Drive wheel, Rotating handle, Stainless Wire, Wooden board, L-Iron, Nuts and Bolts, paint, Brushes
- Machines and Tools:- Drilling machine, Welding machine, Iron saw, Hammer, Plier and Screw drivers

For the durability of the instrument, steel parts must be made out of stainless steel for abrasion resistance and ware and tare resistance. Stainless steel will be perfect instead of aluminum and food-grade steel. This will also help to protect the quality of the flour and help the machine last longer.

Working Principles of the Instrument

The instrument was designed as a fully manual, hand-operated one. The power is supplied to the machine by a hand crank mechanism that is operated by a handle. The handle is rotating a gear wheel system. That system has been used for rotating a blade kept inside the sieve. See Figure 6.

As for the drive wheel, an old wheel from a hand drill was used. The reason for using the wheel of a hand drill is that it uses a bevel gear mechanism to change the direction of drive in a gear system by 90 degrees.

- Bevel gears mechanism in hand drill

Bevel gears are used as the main mechanism for a hand drill. As the handle of the drill is turned in a vertical direction, the bevel gears change the rotation of the chuck to a horizontal rotation.

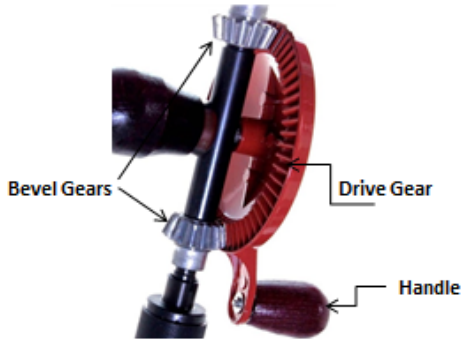

Figure 5: Gear mechanism of the hand drill

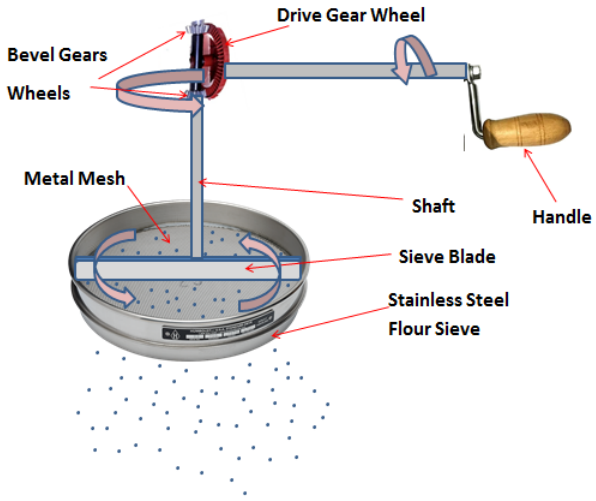

Figure 6: Efficient seiving mechanism used in the new design

The drive gear wheel is rotating vertically by a rotary force that is applying to the handle. Accordingly, bevel gear wheels are rotating horizontally, which rotates the connected shaft of the device. The seive blade, which is connected to the shaft, is always in contact with the metal mesh. The seive blade length is the same as the inside diameter of the flour seive, and the other side (thick side) of the blade is fixed to the shaft end of the device, keeping a 90-degree angle with the metal mesh. The blade is made out of a stiff material, which also has considerable weight. Therefore, even a considerable amount of flour put on the mesh is also distributed over the mesh when it is rotating easily. Because of the effect of the rotary force applied to the blade on both the steel mesh and the flour on it, flour particles are passing through the mesh efficiently.

L-iron was used to make the stand for the instrument, and flour seive was fixed to the stand using nuts and bolts.

III. RESULTS

Figure 7: Final design of the flour sieve

The wooden handle is used to rotate the blade that is touched with the bottom steel mesh to break up flour particles and mix all the flour. This flour sifter rotary hand crank design operates smoothly and effortlessly, and it can stand up to repeated use without tiring out the human hand. This machine is able to reduce accidents or injuries while operating it.

The total cost for the entire design was around 8,000Rs., which is a very small amount compared with the seiving machines used in industries. When manufacturing on a large scale, the cost of the instrument can be further reduced, approximately up to 3000 rupees, by utilizing new technologies.

Testing and Screening Efficiency Calculation

Testing

Testing of the instrument was carried out several times with wheat flour. Small floor particles passed through the mesh, and big or thick particles remained on the sieve. Large flour particles broke into small particles while rotating the blade, so the flour waste was less. Also, one rotation of the handle created six rotations of the blade inside the sieve, because of the wheel mechanism used.

Efficiency Calculation

100g of flour was weighed in a balance, and the efficiency of the device was calculated 5 times with a normal hand speed. As an average, from the start of rotating the handle, it took only 2s and 2 rotations of the handle to finish the sieving of 100g. Therefore, it can be concluded that the efficiency of the sieve is 50 g/s or 180 kg/h. Also, a negligible amount of flour waste remained on the surface of the sieve since the sieve blade broke larger particles into smaller ones.

The same was done using a normal flour sieve, which was tapped 38 times and took me 16s to finish sieving. The efficiency of the sieve is 6.67 g/s or 24 kg/h. Also the tapping becomes tired after a few minutes and difficult to continue for a long time for one person. Large flour particles remained on the sieve, and that amount was large compared to the previous.

As per the literature findings done, the semi-automatic MS flour sifter machine had a speed of 150 kg/h and used a vibrating mechanism, which is a slow method compared to this.

Based on the results it can be concluded that develop flour sieve is more efficient than traditional methods and also even than the electric vibrating flour shifting machines using in the large scale industries.

IV. CONCLUSIONS

This prototype flour sieve machine fits the study's objective requirements and solves the problem based on the analysis findings. The design of the prototype sieve can be improved for industrial scale with very few modifications. A feed hopper can be included, and then flour can be continuously allowed to flow to the sieve at a constant speed.

This new design of the instrument could impact increased productivity and efficiency in production, quality of business products and material processing time, and safety while using it. Also, it can be used domestically, minimizing almost all of the difficulties identified in the traditional tapping method.

V. REFERENCES

[1]. Amazon.com: Flour Sifter, Flour Sifter for Baking, Fine Mesh Sifter, Flour Sieve Fine Mesh, 60 Mesh Sieve 304 Stainless Steel Round Sifter for Baking Straining Powdering 15cm 18cm 20cm. (n.d.). Www.amazon.com. Retrieved November 11, 2023, from https://www.amazon.com/Sifter-Baking-Stainless-Straining Powdering/dp/B08PHT7WND?th=1

[2]. Flour Sifter Machine. (n.d.). Indiamart.com. Retrieved November 11, 2023, from https://www.indiamart.com/proddetail/flour-sifter-machine-27573525555.html

[3]. Ismail, M. E., Razali, N., Hashim, S., Masek, A., & Ismail, I. M. (2022). Design and Analysis of Flour Sieving Machine Prototype Using Autodesk Inventor. Journal of Positive School Psychology, 6(2), 2625–2631. https://journalppw.com/index.php/jpsp/article/view/1841

[4]. Project Proposal Report Flour Sieving Machine Team Members: Matrix No. (n.d.). Retrieved November 11, 2023, from http://repository.psa.edu.my/bitstream/123456789/3573/1/automatic%20sieve%20machine.pdf

[5]. Separation solution: Choose an electric flour sifter. (n.d.). Www.linkedin.com. Retrieved November 10, 2023, from https://www.linkedin.com/pulse/separation-solution-choose-electric-flour-sifter-qiqi-wei-gu5lf/?trk=article-ssr-frontend-pulse_more-articles_related-content-card

[6]. Should I Sift Flour? (Advantages and Disadvantages) | The Dough Academy. (n.d.). The Dough Academy. Retrieved November 10, 2023, from https://thedoughacademy.com/should-i-sift-flour-advantages-and-disadvantages/

[7]. Fernando, W.L.W.,Basnayake, B.M.V., Fernando, H.A.S., Rajapaksha, H.M.P.B., Rodrigo, S. and TheresLathanky, J. (2014). Designing a vibrating sieve.

[8]. Dipak, U., Adhapure, S., Bhoite, V., Deshpande, U., Chavan, S. and More (n.d.). Design and Fabrication of Multi-purpose Sieving Machine. International Journal of Research in Engineering

and Science (IJRES) ISSN, [online] 9, pp.44–49. Available at: https://www.ijres.org/papers/Volume-9/Issue-7/Series-10/F09074449.pdf.

[9]. FACULTY OF MECHANICAL ENGINEERING DIPLOMA IN MECHANICAL ENGINEERING (PROJECT 2 DJJ 6143) FINAL REPORT OF : FLOUR SIEVING MACHINE PREPARED FOR : ENCIK TENGKU MOHD AIZAN BIN TENGKU MOHAMMAD PREPARED BY. (n.d.). Available at: http://repository.psa.edu.my/bitstream/123456789/3131/1/Flour%20Sieving%20Machine.pdf.

[10]. www.iqsdirectory.com. (n.d.). Bevel Gear: What Is It? How Does It Work? Types, Uses. [online] Available at: https://www.iqsdirectory.com/articles/gear/bevel-gear.html.

[11]. Ismail, M.E., Razali, N., Hashim, S., Masek, A. and Ismail, I.M. (2022). Design and Analysis of Flour Sieving Machine Prototype Using Autodesk Inventor. Journal of Positive School Psychology, [online] 6(2), pp.2625–2631. Available at: https://journalppw.com/index.php/jpsp/article/view/1841.

[12]. www.youtube.com. (n.d.). Simple Flour Sieve Machine. [online] Available at: https://www.youtube.com/watch?v=mp45ZrUhZRU [Accessed 19 Nov. 2023].

[13]. www.youtube.com. (n.d.). |Delite |vibroscreen|vibro sifter |Gyro screen|Sieving Equipment |Vibro Separator |vibrating screen. [online] Available at: https://www.youtube.com/watch?v=2ZEX7djS0yE [Accessed 19 Nov. 2023].

[14]. Company, C.S. (n.d.). Sieves, Sieving, Sieve Analysis, Sieve Testing. [online] www.cscscientific.com. Available at: https://www.cscscientific.com/particle-size/sieves#:~:text=Sieves%20are%20used%20for%20a [Accessed 19 Nov. 2023].