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Design and Construction of Crimping Press Equipment Perfume Bottle Sprayer (Crimper)

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Abstract

This research examines the Perfume Bottle Sprayer Crimping Press Tool (Crimper), designed to install the sprayer on perfume bottles using the principle of a simple lever-type device. The focus of the research was to evaluate the reliability of the tool in preventing leaks at various heights of perfume bottles. The Crimper manufacturing process includes using a milling machine to form flat sides, cutting with a grinder for precise dimensions, and welding using a TIG welding machine with argon gas to maintain the strength of the stainless steel. Tests carried out on perfume bottles with heights of 95 mm, 68 mm, and 71 mm showed that the Crimper was successful in preventing leaks in all tests. The results confirm the reliability and efficiency of tools in industry, in line with the demands of an increasingly competitive global market. Thus, Crimper not only meets technical specifications but can also be relied on to increase production efficiency and maintain consistent product quality.

Keywords: Tool design, press tool, perfume bottle sprayer, lever lever

INTRODUCTION

In this modern era, technology is a key factor in everyday life, which is increasingly being accelerated by the industrial revolution 4.0. Technology plays an important role in various aspects of life, including industry, with the main aim of making it easier for humans to complete their work more efficiently and effectively.

In the manufacturing industry, competition between producers to improve quality, marketing reach and speed of the production process is very tight. This is done to meet consumer demand which continues to increase and changes rapidly. One sector that is experiencing rapid development is the perfume industry. Perfume products are now in demand by various groups, from entrepreneurs to students, so demand for perfume continues to increase [1]. As demand increases, perfume manufacturers are trying hard to make their products more attractive. One

effective way is through attractive and functional packaging design. Good packaging not only protects the product, but also has an important role in marketing and branding [2]. The physical appearance of packaging is often a determining factor in consumer purchasing decisions, both planned and spontaneous.

Research shows that good product design can influence sales success. An attractive perfume packaging design can increase the aesthetic value of the product, make it more attractive to consumers, and create a positive image for the company. Therefore, perfume manufacturers continue to develop various bottle shapes and innovative sprayer mechanisms [3]. One important component in perfume packaging is the bottle sprayer, which is often installed using a crimping technique. The process of installing this sprayer is usually carried out manually using simple tools such as pliers, which although effective, has several limitations and difficulties [4]. The use of more sophisticated and efficient crimping tools, although expensive, can greatly help in increasing production efficiency and quality.

Seeing this need, this research aims to design and make a simple but effective crimping tool using the lever lever principle. The designed crimping tool will have a height-adjustable neck, allowing for more flexible adjustments and providing a mechanical advantage so that the effort (force) expended is less. Thus, it is hoped that this tool can be a more efficient and economical solution for perfume manufacturers in installing sprayers on perfume bottles.

This research not only focuses on the design and construction of the tool, but also on testing the effectiveness of the tool in increasing production efficiency and the quality of sprayer installation. With better crimping tools, it is hoped that perfume manufacturers can increase their productivity, reduce production costs, and increase product competitiveness in the market.

RESEARCH METHODS

This research uses a quantitative and experimental approach to design, develop and test the effectiveness of a crimping press for perfume bottle sprayers. This approach was chosen to ensure that research results can be measured and analyzed objectively, which can be seen in **Fig. 1**.

Fig. 1. Research Scheme

1. Study of literature
   At this stage, we need to understand the background and context of the research, identify knowledge gaps, build a theoretical foundation, and determine an appropriate methodology. This helps researchers avoid duplication, find relevant instruments, and identify previous findings that support their research. In addition, literature studies allow researchers to recognize potential obstacles and establish the position of their research in a broader scientific context, thereby ensuring that the research conducted is relevant, meaningful, and contributes significantly to the field of science.
2. Design
   This stage designs and develops a crimping press device that can be used to install the sprayer on perfume bottles efficiently and effectively. This design includes technical specifications, material selection, and the working mechanism of the tool, which uses the lever principle to facilitate the crimping process [5]. The main objective of this design is to create a tool that is simple, affordable, and able to increase productivity and the quality of installing sprayers on perfume bottles, so that it can meet the needs of perfume manufacturers in overcoming the difficulties of manual installation.
3. Assembly/Tool making
   The purpose of this research is to create a practical and efficient crimping press device for installing sprayers on perfume bottles. This tool is designed to overcome the obstacles faced in manually installing sprayers, such as inaccuracy and time. By using the lever principle, this tool is expected to reduce the physical effort required and increase the consistency of crimping results [6]. The aim of making this tool is to provide a more economical and effective solution for perfume manufacturers so that they can increase productivity and production quality.
4. Analysis and testing
   The analysis and testing in this research aim to evaluate the performance and effectiveness of the crimping press tool that has been designed and made. The test was carried out by operating a tool to

install the sprayer on the perfume bottle, then measuring the results in terms of time required, crimping strength, and installation quality. The data obtained from this test is then analyzed quantitatively to determine whether the tool meets the expected specifications and is able to increase process efficiency compared to manual methods.

5. Results

   The results to be achieved in this research method are the development and validation of an effective crimping press tool for installing sprayers on perfume bottles. This tool is expected to increase the efficiency of the production process in the perfume industry by significantly reducing sprayer installation time compared to manual methods. Apart from that, this tool is also expected to be able to produce consistent and strong crimping quality, so that it can increase consumer confidence in the perfume products being marketed. With the successful development of this crimping tool, it is hoped that it can provide a practical and economical solution for perfume manufacturers to increase productivity and reduce production costs, as well as provide added value in terms of speed and quality of the products produced.

RESULTS AND DISCUSSION.

Design of Perfume Bottle Sprayer Crimping Press Equipment

In this research on the production process, technical drawings have a very important role because they function as the main guide in manufacturing and assembling components. Technical drawings are used to determine the dimensions and detailed specifications of each part of the tool or product to be produced. In this research, the author used SolidWorks 2017 drawing design software to design a press-crimping sprayer for perfume bottles [7]. The aim of making technical drawings for press crimping tools is to clearly illustrate the shape, size, and function of each component, making it easier for readers to understand the technical specifications of the tool and simplifying the manufacturing and assembly process. The results of the tool design can be seen in **Fig. 2**.

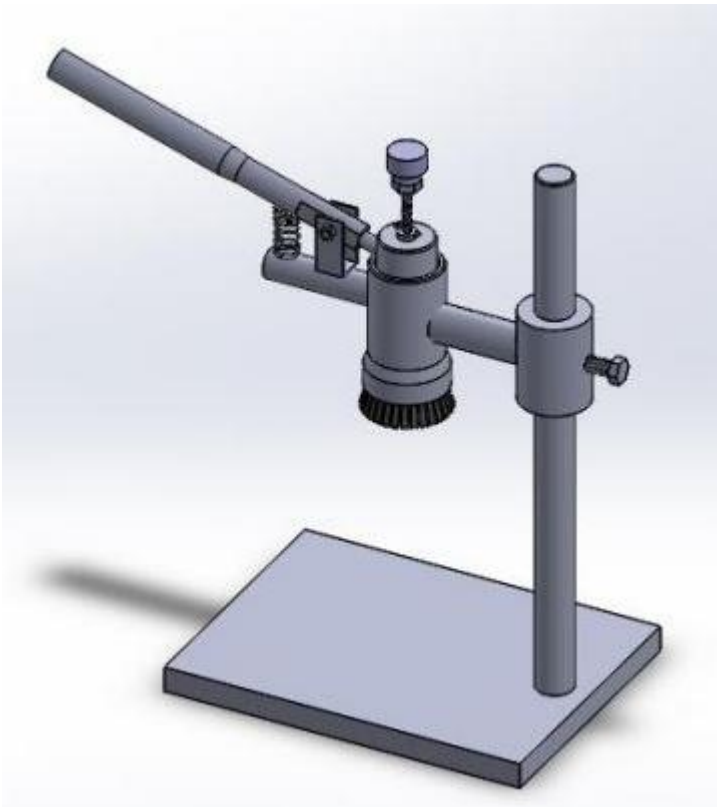


Fig. 2. Design of Perfume Bottle Crimping Sprayer Press Tool

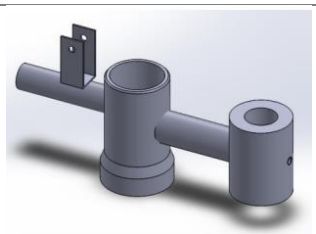
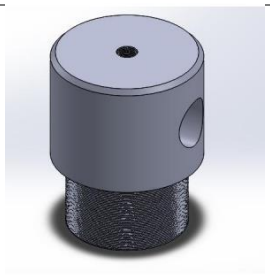
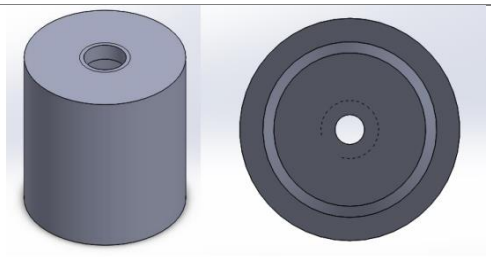
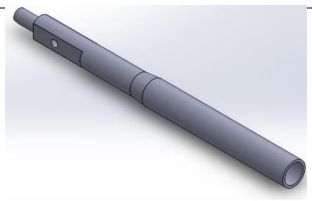
The purpose of designing drawings of perfume bottle sprayer crimping press tools is to provide detailed and comprehensive guidance regarding the physical and technical characteristics of the tool. Using design software such as SolidWorks 2017, these engineering drawings allow for accurate and in-depth visualization for related professionals, such as engineers and technicians, involved in the production process and tool use. Figure

2. not only facilitates a clear understanding of the shape and dimensions of the tool but also ensures that each component can be designed and manufactured in accordance with established technical standards. Thus, this press crimping tool can be applied efficiently and effectively in the perfume industry, optimizing the manufacturing, assembly, and use of sprayers on perfume bottles [8].

The working principle of the press crimping sprayer (Crimper) is to attach the sprayer to the perfume bottle by attaching the bottom of the sprayer to the neck of the bottle [9]. This is done to ensure that the sprayer is installed tightly so as to prevent fluid leakage through the installed sprayer area. This press tool uses the principle of the first type of lever, where the fulcrum is between the load and the force. The tool handle is used to lift the press eye, which acts as a load in this lever-lever principle. The height of the press eye can be adjusted by sliding the neck, which is connected to the pole, and by loosening and tightening the bolt to ensure the tool is locked in position. During the use process, the handle is pressed down so that the tip lifts the press eye. When the press eye is lifted, the floating bottom part will be pinched by the eye nest, causing the inner diameter of the eye to shrink and bending the sprayer wall to the desired size. Once the sprayer is installed properly, the handle is released so that the press eye returns to its original position, allowing the bottle equipped with the sprayer to be used directly.

From the design results of the perfume bottle sprayer crimping press tool design, the components can be determined as shown in **Table 1.**

Table 1. Table of tool components

No	Description	Picture
1	The neck is the part that functions as a support for the position of the press eye and also as a place to adjust the height of the press eye.	
2	Component Eye Mount, the head is the component that is the place to install the press eye using threads	
3	Sprayer Holder Functions as a sprayer holder to adjust the height of the sprayer when it is installed.	
4	The handle is a lever that is used to move the head component so that the press eye presses the sprayer so that it is attached to the perfume bottle	

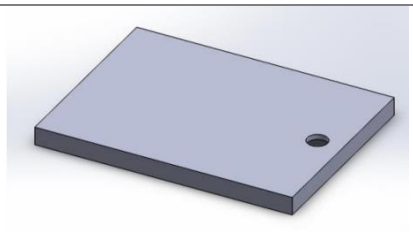
5	The base is the base or position of the tool	
6	The pole is a cylindrical rod that is perpendicular to the base, functioning as a rod to which the neck is attached to regulate the height of the press eye	
7	The press eye acts as a punch that presses the sprayer so that it sits flat on the perfume bottle.	
8	These complementary components function as complementary tools when assembled and have different functions and positions. These components are not produced because they are already circulating on the market and are easy to find with predetermined standard parts such as bolts, nuts, threaded rods, hexagon bolts, knurled thumb nut and spring	

Table 1. shows the components used to make a perfume bottle sprayer crimping press tool. After determining these components, the next step is to carry out calculations in the design to ensure the tool functions as expected. This calculation includes an analysis of material strength, a determination of component dimensions, and an evaluation of the force required for the crimping process. With correct calculations, it is hoped that the tool can work optimally and efficiently in installing the sprayer on the perfume bottle.

Normal Force at the base of the pile [10],[11].
Normal force = Heavy force

$$N = W \quad (1)$$

Mast mass = 781.6 grams

Neck mass = 832 grams
Head mass = 218.9 grams
Eye mass = 161.3 grams
Total mass (m) = 781.6 + 832 + 218.9 + 161.3 = 1993.8 grams = 1.99 Kg

Gravity W = m.g (2)
W = 1.99 Kg. 9.8m/s2
W = 19.5 Kgm/s2
W = 19.5 NN = 19.5 N
The normal force at the base of the pole is 19.5 N

Spring force [11]
Spring pressing force (F)

$$\delta = 18\ mm = 0{,}018\ m$$

D = 11 mm = 0.011 md = 1.5 mm = 1.5 . 10-3 m
modulus of elasticity (G) = 1.96 . 106 Kg/cm2 = 1.96 . 1010 Kg/m2

$$F = \frac{\delta \cdot d^4 \cdot G}{8 \cdot D^3 \cdot n}]$$

$$[F = \frac{0.018\ m \cdot (1.5 \cdot 10^{-3}\ m)^4 \cdot 1.96 \cdot 10^{10}\ \text{Kg/m}^2}{8 \cdot (11 \cdot 10^{-3}\ m)^3 \cdot 8}]$$

$$[F = \frac{0.178605 \cdot 10^{-12} \cdot 10^{10}\ \text{Kg}}{113^3 \cdot 8 \cdot 8 \cdot 10^{-9}\ \text{Kg}}]$$

$$[F = \frac{178605 \cdot 10^{-6} \cdot 10^{-2}\ \text{Kg}}{85184 \cdot 10^{-9}\ \text{Kg}}]$$

$$[F = \frac{85184\ \text{Kg}}{178605 \cdot 10}]$$

$$[F = 20.97\ \text{Kg}]$$

Spring index (C)
C = D/d
C = 11mm / 1.5mm
C = 7.3

$$k = \frac{G \cdot d}{8 \cdot n \cdot C^3}$$

$$k = \frac{1.96 \cdot 10^{10}\ \text{Kg/m}^2 \cdot 1.5 \cdot 10^{-3}\ m}{8 \cdot 8 \cdot 7.3^3}$$

$$k = \frac{2.94 \cdot 10^7\ \text{Kg/m}}{24897}$$

$$k = 0.00011808652 \cdot 10^7\ \text{Kg/m}$$

$$k = 1180.9\ \text{Kg/m}$$

Restorer style

$$F = k \cdot \delta$$

$$F = 1180.9\ \text{Kg/m} \cdot 0.018\ m$$

$$F = 21.2562\ \text{Kg}$$

$$F = 208.31\ \text{N}$$

Bending force [10]
sprayer Bending thickness (t) = 0.5 mm T
Aluminum Tensile strain = 90 N/mm2
Constant (C) = 2 (maximum)
B = circumference of circle = $\pi . D$
D = 15mm

$$P = \frac{C}{3} \cdot B \cdot t \cdot \text{Tegangan Tarik}$$
$$P = \frac{2}{3} \cdot (3.14 \cdot 15) \cdot 0.5 \text{ mm} \cdot 90 \text{ N/mm}^2$$
$$P = \frac{2}{3} \cdot 47.1 \cdot 0.5 \cdot 90 \text{ N/mm}^2$$
$$P = 1413 \text{ N}$$

The results of component calculations can be seen in **Table 2.**

Table 2. Component calculation results

No	Urain	Results
1	Large load on the lever	Number of stems (n) = 24
2	The force (F) is calculated using the leaf spring force	460.8 N
3	Calculate FA using the sine rule	F = 1581.724 N
4	Lever length	166mm
5	Twisted Strength	696 N/mm2
6	Mechanical advantage gained	of 5.67

The production process of the perfume bottle sprayer crimping press (crimper) consists of two main stages, namely component manufacture and assembly.

Making

The process of making components includes several machining stages, namely the turning stage (lathe): The turning process is used to form cylindrical objects through diameter reduction, drilling, and facing, which can be seen in **Fig. 3**.

Fig. 3. Component turning process

Drilling (Drilling Machine) Drilling that cannot be done on a lathe, such as drilling on the base and on the cylinder wall, can be seen in the work process in **Fig. 4**.

Fig. 4. Drilling process

The process of making this tool involves several important stages. First, use a milling machine to process flat objects, especially in forming flat sides on cylindrical objects. Next, cutting is carried out using a grinder to achieve dimensions that meet the required specifications. The tool assembly process involves welding with a TIG (tungsten inert gas) welding machine, which was chosen because the basic component used is stainless steel, so it requires welding with argon gas to maintain the strength and durability of the material. After the work stage is complete, polishing is carried out using a grinding machine with a polishing wheel and green stone (langsol) as the medium, with the aim of restoring the original color and shine of the stainless steel after the work process is complete. The grinding process can be seen in **Fig. 5.**

Fig. 5. Grinding process

After the assembly process is complete, this tool takes its final shape after all components are joined together using bolts and nuts. A visual representation of the assembled tool can be seen in **Fig. 6.**

Fig. 6. Result of tool assembly

Testing stage

Tool testing is carried out to evaluate performance and ensure that the tool can function effectively according to the stated objectives. The main objective of the test includes two important aspects, namely the absence of leaks after installing the sprayer on the bottle and the ability of the tool to install the sprayer on bottles at varying heights. To achieve this goal, testing was carried out using a Crimper tool and a 12 mm sock wrench. Materials used in testing include perfume bottles with varying heights, perfume liquid, 15 mm sprayer, and tissue or paper to check for leaks after installation.

The testing process is carried out repeatedly using perfume bottles of different heights, with tissue or paper used as a tool to detect leaks after the installation process. The testing stages begin with preparing the perfume bottle, sprayer and perfume liquid. After that, tests are carried out by putting these components together to evaluate the reliability of the tool in practical conditions. This test not only ensures the effectiveness of the tool in preventing leaks, but also measures the tool's ability to operate consistently under a wide variety of existing perfume bottle conditions.

Fig. 7. Testing Materials

Fig. 8. Press Eye Height After Adjusting

After a series of tests have been carried out, the results obtained are arranged in tabular form to facilitate data analysis and interpretation. The table summarizes the performance of the tool based on predetermined criteria, namely resistance to leaks and the ability of the tool to install the sprayer on bottles at different heights. The data presented in this table provides a comprehensive picture of the effectiveness and efficiency of the tools tested. The following **Table 2** shows the results of the tests that have been carried out.

Table 2. Test Results

Test	Bottle Type	Bottle Height	Leak Test
1	V32662 50 ml	95mm	There isn't any
2	V32260 50 ml	68mm	There isn't any
3	V32651 30 ml	71mm	There isn't any

Based on the test results in table 2 above, which were carried out three times on three types of bottles with different heights, the results showed that the sprayer was successfully installed without any leaks. The results of this test show that the perfume bottle sprayer crimping press (crimper) is able to work effectively in various bottle height conditions.

This crimper functions well and fulfills its intended purpose. This tool not only succeeded in preventing leaks, but also demonstrated consistent performance in installing the sprayer on perfume bottles at varying heights. These results provide confidence that this crimper tool is ready to be used in the production process with high efficiency and reliability. However, to ensure that the crimper continues to operate at optimal performance levels, it is essential to implement proper maintenance. By carrying out preventative maintenance, such as regular cleaning to remove dust, dirt or liquids that could contaminate the tool, we can ensure that the crimper remains in top condition and ready to be used whenever needed. Good maintenance not only extends the life of the tool, but also maintains the efficiency and reliability of the tool in the long term, thereby supporting the success of the overall production process [12].

On this perfume bottle press crimping sprayer (crimper), cleaning is carried out regularly to ensure the tool is free from dust, dirt or liquids that could contaminate the shape or performance of the tool [8]. By carrying out regular cleaning, tool performance can remain optimal, and the risk of damage or reduction in the quality of work results can be minimized. Proper and regular cleaning not only keeps the tool clean, but also extends the life of the tool and ensures that the tool is always ready to use whenever needed.

This research tested the Perfume Bottle Sprayer Crimping Press Tool (Crimper) in the context of leak testing on perfume bottles at various heights. The results show that the Crimper can reliably install the sprayer without leaks, demonstrating high consistency and effectiveness in practical industrial applications. By using stainless steel material and a bolt-on press eye adjustment mechanism, this tool not only meets technical specifications with precise dimensions (200 mm x 150 mm x 310 mm), but also succeeded in field testing with no leaks after several times testing. This success is in line with previous research results which highlight the importance of strong design and corrosion-resistant materials to maintain long-term tool reliability.

Previous studies, such as those conducted by Smith et al. [13], evaluated the efficiency of crimping tools in the bottle production process with a focus on leakage and sealing quality. They found that the use of appropriate materials and efficient design were essential to avoid leaks and improve tool performance. Another study by Johnson et al. [14] showed that flexible adjustment mechanisms in crimping tools can improve adaptability under various production conditions, in line with your findings about the use of bolts to adjust press bits.

In research conducted by Brown et al. [15] underlines the importance of preventive maintenance in maintaining the performance of crimping tools. They suggest regular cleaning and maintenance as key factors in maintaining tool reliability and efficiency over the long term, supporting your findings about the need for proper maintenance to ensure the Crimper remains operating at optimal levels. Thus, this research not only expands knowledge about perfume bottle sprayer crimping technology, but also contributes to the development of best practices in the relevant industry

CONCLUSIONS.

Based on a series of manufacturing and testing processes that have been carried out on the perfume bottle sprayer crimping press tool, it can be concluded that this tool meets the specified technical and operational criteria. The tool produced has dimensions of 200mm x 150mm x 310mm, with the main frame material being made of stainless steel which provides strength and resistance to corrosion. The press eye adjustment mechanism using a bolt allows vertical movement of the tool neck, so that it can be adjusted to various sizes of press eye as needed. The test results show that this tool functions well, as indicated by the absence of leaks after several tests. This success indicates that this crimping press has high reliability in maintaining the integrity of the sprayer seal on perfume bottles, even at different bottle height variations. Thus, this tool not only meets the expected technical specifications, but also proves its efficiency and effectiveness in practical applications in industry. This conclusion supports the use of a crimping press as a reliable and efficient solution in the perfume bottle production process

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