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Design and Development of Fuzzy Logic Control Systems on Bottled Drinking Water Pressing Equipment

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Abstract. Pressing system in drinking water in the form of glass is mostly completly in all scale production. Almost all companies large or small use this tool in its packaging. There is often a decline in the quality of bottled water caused by peeling off the lid on the package. Peeling off the lid of bottled water is caused by the pressing process when drinking water production does not match the glass material and the temperature of the pressing device. The thickness and temperature of the pressing tool as an indicator or input in obtaining pressure output (pressing) for the quality of drinking water packaging results. Therefore this study will discuss the design of control systems in the process of pressing bottled drinking water. input adalah ketebalan bahan kaca dan suhu pada proses pers. The system will be controlled using the fuzzy logic control method to obtain the value of the pressure at the system output.

Keyword :Pressing System, Quality of Bottle, Fuzzy Logic, Pressure.

1. Introduction

Bottled drinking water is water that is packaged using technology to maintain the quality of water in a glass. The use of glass as a container for drinking water is important in terms of maintaining water quality when consumed or in a storage room[1]. The good quality of packaging in bottled drinking water depends on the quality of the ingredients and the pressing process at the company or production site[3].

Some problems that occur due to the process of pressing that is not in accordance with good packaging standards including plastic caps on the packaging often peeling[2]. Decreasing water quality because the pressing process does not pay attention to the thickness of the material and the pressing temperature so that the packaging is not perfect[4]. The pressing process requires an ideal temperature[5].

Some research related to the process of pressing the packaging of drinking water only discusses the function of the tool and the use of the tool in the pressing modification. Not many researchers pay attention to the thickness of the material and the ideal temperature in the drinking water packaging press[6]. In this study the focal point of the study is to make a simulation of fuzzy logic control with input thickness of the material and the temperature of the pressing device. Armed with these two inputs, the output value in the form of pressure will be obtained. Output pressure is expected to be the solution to the problems with drinking water packaging.

2. Methods

Pressing simulation of drinking water packaging is done using the Matlab application. In this case consists of two inputs in the form of thickness of the glass material and the temperature of the pressing tool. Utilization of two inputs will control the output in the form of pressure applied to the packaging process. In this determination the control method used is fuzzy logic control. Fuzzy logic control design can be seen in Figure 1.

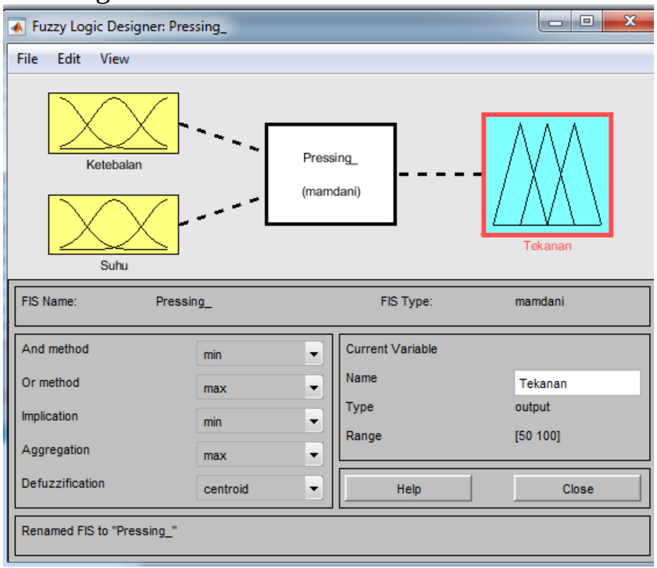

Figure 1. Fuzzy Pressing System Design

Fuzzy logic control in this system uses the Mamdani concept. The fuzzy provisions in this research are as follows.

a. Inputs on glass thickness range from 0 - 2.5 mm with membership functions are very thin, thin, normal, thick and very thick.

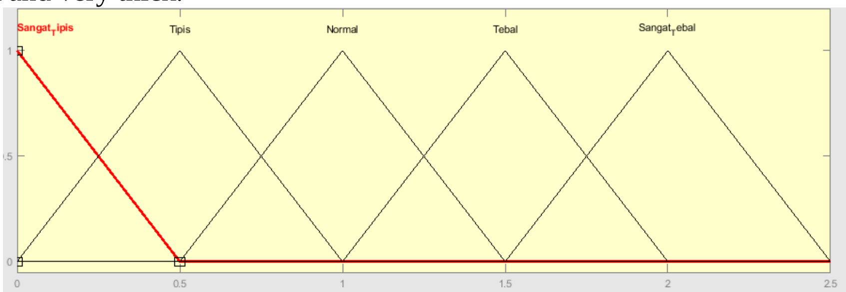

Figure 2. Membership Function Thickness

b. The input temperature of the pressing device ranges from 0-100 ^{o}C with the categories Cold (50 – 60 ^{o}C), Normal (50 – 70 ^{o}C), Hot (60 – 80 ^{o}C), Medium Hot (70 – 90 ^{o}C) and Very Hot (80 – 100 ^{o}C).

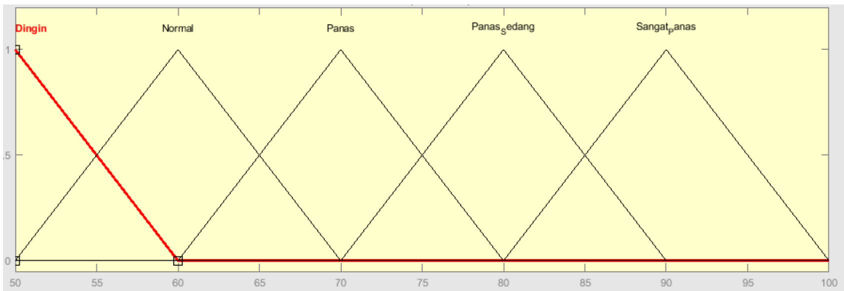

Figure 3. Temperature Membership function

Fuzzy rules are obtained based on thickness and temperature input consisting of 25 rules. These rules are shown in the form of a fuzzy rule base. The following fuzzy rule base on this system:

1. If (Ketebalan is ST) and (Suhu is Dingin) then (Tekanan is Sedang) (1)
2. If (Ketebalan is ST) and (Suhu is Normal) then (Tekanan is Normal) (1)
3. If (Ketebalan is ST) and (Suhu is Panas) then (Tekanan is Kecil) (1)
4. If (Ketebalan is ST) and (Suhu is Panas_Sedang) then (Tekanan is Kecil) (1)
5. If (Ketebalan is ST) and (Suhu is Sangat_Panas) then (Tekanan is Sangat_Kecil) (1)
6. If (Ketebalan is T) and (Suhu is Dingin) then (Tekanan is Sedang) (1)
7. If (Ketebalan is T) and (Suhu is Normal) then (Tekanan is Sedang) (1)
8. If (Ketebalan is T) and (Suhu is Panas) then (Tekanan is Kecil) (1)
9. If (Ketebalan is T) and (Suhu is Panas_Sedang) then (Tekanan is Sangat_Kecil) (1)
10. If (Ketebalan is T) and (Suhu is Sangat_Panas) then (Tekanan is Sangat_Kecil) (1)
11. If (Ketebalan is N) and (Suhu is Dingin) then (Tekanan is Tinggi) (1)
12. If (Ketebalan is N) and (Suhu is Normal) then (Tekanan is Sedang) (1)
13. If (Ketebalan is N) and (Suhu is Panas) then (Tekanan is Normal) (1)
14. If (Ketebalan is N) and (Suhu is Panas_Sedang) then (Tekanan is Kecil) (1)
15. If (Ketebalan is N) and (Suhu is Sangat_Panas) then (Tekanan is Sangat_Kecil) (1)
16. If (Ketebalan is Tb) and (Suhu is Dingin) then (Tekanan is Tinggi) (1)
17. If (Ketebalan is Tb) and (Suhu is Normal) then (Tekanan is Tinggi) (1)
18. If (Ketebalan is Tb) and (Suhu is Panas) then (Tekanan is Sedang) (1)
19. If (Ketebalan is Tb) and (Suhu is Panas_Sedang) then (Tekanan is Sedang) (1)
20. If (Ketebalan is Tb) and (Suhu is Sangat_Panas) then (Tekanan is Normal) (1)
21. If (Ketebalan is STb) and (Suhu is Dingin) then (Tekanan is Tinggi) (1)
22. If (Ketebalan is STb) and (Suhu is Normal) then (Tekanan is Tinggi) (1)
23. If (Ketebalan is STb) and (Suhu is Panas) then (Tekanan is Tinggi) (1)
24. If (Ketebalan is STb) and (Suhu is Panas_Sedang) then (Tekanan is Sedang) (1)
25. If (Ketebalan is STb) and (Suhu is Sangat_Panas) then (Tekanan is Sedang) (1)

Figure 4. Rule Base Fuzzy System

c. Output in the form of pressure with a membership function is very small, small, normal, medium and high.

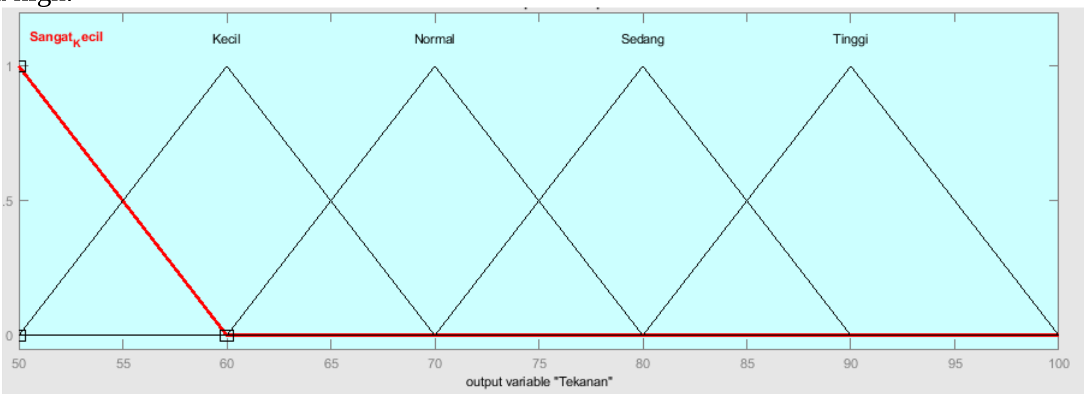

Figure 5. Membership function output

3. Results and Discussion

This research was conducted to obtain simulation results in the form of a drinking water packaging press system. The results of the simulation will be the basis for the application of production in the company's machinery or home water packaging industry. The scenario of simulation testing is carried out on two grounds. First the disturbance is given to the size of the thickness of the glass. Both disturbances are given at the pressing temperature. Both of these scenarios will display control results in the form of a large amount of pressure in the packaging process. Figure 6 shows the effect on the pressure generated in the pressing process. When the temperature gets higher, the pressure applied to the tool also gets smaller. In this case the lowest temperature on the press is 50 ^{o}C.

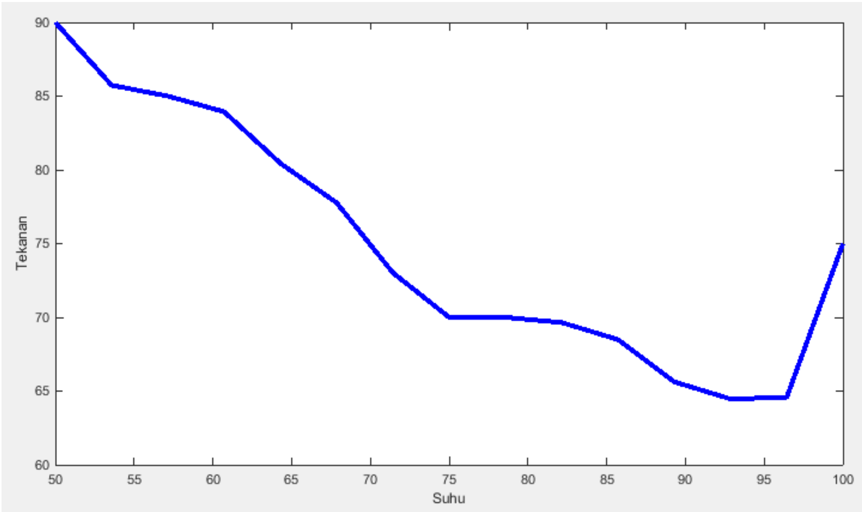

Figure 6. Effect of temperature on pressure

Figure 7 shows the result that the thicker the glass used in packaging, the greater the pressure applied to the packaging process. If you look at the graph between the influence of temperature and thickness is inversely proportional because the two variables are different, but when they are correlated it will produce an ideal pressure for the pressing process in packaging. The ideal conditions of pressure applied to the process are shown in Figure 8.

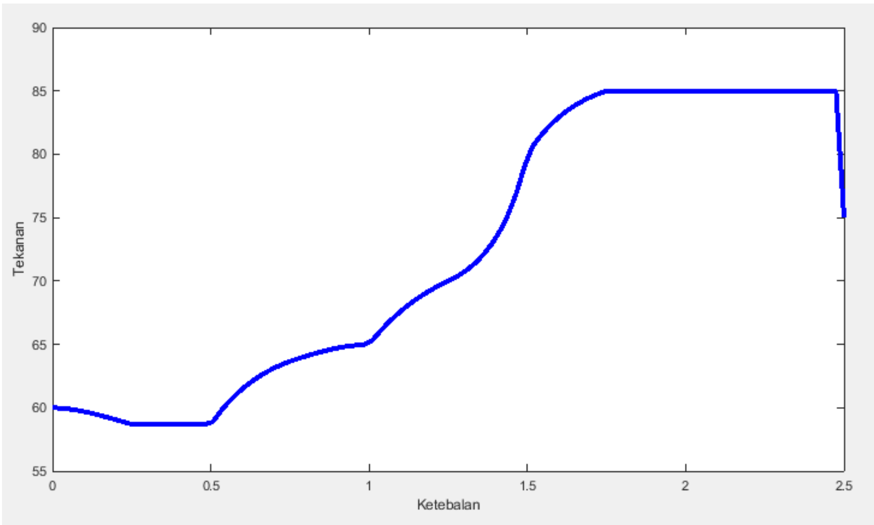

Figure 7. Effect of thickness on pressure

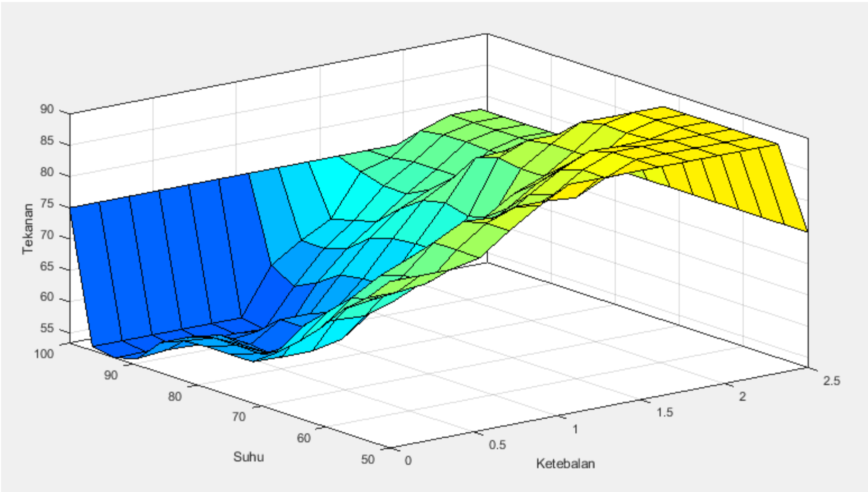

Figure 8. Result of Simulation

4. Conclusion

From the results of this study it can be concluded that the process of pressing the packaging of drinking water by two indicators, namely the temperature and thickness of the container. The maximum pressure given from the results of this simulation is 90 bar with respect to the thickness and temperature input values. This simulation method can be applied in the process of pressing the packaging of drinking water.

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