DESIGN OF CORROSION TEST MECHANISM WITH PNEUMATIC SYSTEM FOR WINDOW ESPAGNOLETTE COUNTER

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ABSTRACT
Pneumatic systems are used for various different aims in modern industrial automation applications. Pneumatic systems implement many functions like drilling, punching, riveting, tapping, deescalating/lifting, pulling/pushing, clamping, stopping etc. with the help of cylinders. In this study, a test mechanism is designed for PVC door and window systems which are used frequently in the daily lives. With the designed mechanism, PVC window crank arm is automatically opened/closed, the corrosion values are stated and lifespan tests are realised.

Keywords: *Pneumatic System, Window, Corrosion Test, Espagnolette*

INTRODUCTION

Pneumatic is a field that deals with the processing, control and transmission of compressed air by processing the air present in the atmosphere. Pneumatic systems are also machines where motion and power are generated by compressed air. It is possible to create simple and fast running systems to achieve linear, angular and rotational movements that do not require very high forces [2].

In the atmosphere, the air is a mixture of different gases. There exists mainly nitrogen (78%) and oxygen (21%) together with carbon dioxide, hydrogen, neon, argon, helium, krypton, xenon and water vapor. In order to be able to use pneumatic systems safely, the produced pressurized air must be supplied to the system under the desired conditions. In order for the compressed air to be of the desired quality, the pressure must be appropriate and controllable, and the air must be dry and clean.

Advantages of pneumatic systems

The air required for pneumatic systems can easily be found anywhere in the atmosphere. Air friction losses are low and can be transported to long distances with low losses. Compressed air does not create pollution in the environment where it is used.

- The environment is your friend.
- The production of pneumatic equipment is easy and cheap.
- Installation and maintenance can be done easily.
- It is safe because it is not flammable and explosive.
- The properties of the air used do not change with temperature.
- Storability is easy.
- Operating speeds are high.

Disadvantages of pneumatic systems

- Air must be prepared before use.
- Use at high forces is not appropriate.
- The sound of the air blown from the system is high. A muffler is required to be used.
- Positioning accuracy is poor as air can be compressed under high pressure.
- Using at very high operating pressures is not appropriate.

Pneumatic systems are generally compared with hydraulic systems because of their similar application areas. When hydraulic systems are compared to pneumatic systems, hydraulic oils used as hydraulic fluids in hydraulic systems are considered incompressible. However, when working at very high pressures it can be compressed in small amounts. The air used as a fluid in

pneumatic systems is compressible. Temperature variations in pneumatic systems do not affect fluid velocities. Elevations in fluid temperature do not constitute a danger of explosion or combustion. In hydraulic systems, since oil used as a fluid exhibits flammable properties, a hazard due to oil usage appears. In addition, the increase in fluid temperature changes the viscosity of the hydraulic fluid and affects the system operating speeds. The fluid used in the hydraulic system ensures that the circuit elements are lubricated during operation. The system is protected against abration and corrosion, although no extra lubricants are needed on this vault. In pneumatic systems, when the air lacks lubrication property, the system components are damaged. For this reason, before used in the system, air must be fed with lubricants and must be given the property of lubricating. Achieving high forces in pneumatic systems can be achieved easily and safely in hydraulic systems when it is difficult and unsafe to achieve. However, the installation costs of hydraulic systems are higher than those of pneumatic systems. While pneumatic systems can operate at high operating speeds, hydraulic systems operate at lower speeds [1].

Abrasion

Friction is defined as the resistance of two materials against moving, in contact with each other, moving or tending to move relative to each other. Abrasion is defined as material loss on friction surfaces. The amount of abrasion depends on the type of material, the shape of the friction surfaces, the friction conditions and the chemical effects of the environment [3].

Abrasion and abrasion types

In an abrasion mechanism, abrasion (main material), abrasive (counter material), fill (intermediate material) are the basic components of force and motion abrasion. The tribological system is the system in which all these elements come together.

Wear tests and measurement methods

The American Society of Lubrication Engineers (ASLE) has identified up to a hundred test systems in the determination of abrasion. The most commonly used ones are abrasion amount, thickness difference and trace change methods.

• Weight Song Method

It is the most used and most economical method among measurement methods. In order to make the measurements of the specimens, the specimens must be removed from their places and measured on an external measuring instrument. The most important disadvantage of the method is that it can not be measured while on the test setup. The amount of abrasion can be measured with very precise scales. If amounts of abrasion are given in milligrams and grams, the amount of weight loss corresponding to the unit friction path, in terms of the friction path measured in meters or kilometers, can be expressed in terms of gr / km, mg / m. If the weight loss is expressed in terms of area, a unit such as gr / cm2 can be used.

- **Thickness Method**

The measurement of the dimensional change that will occur in the course of abrasion is obtained by comparing the initial measurement value with the final measurement value.

Based on this value determined as the thickness difference, the volume loss amount or the wear value in the unit volume is calculated. Thickness values can be measured with sensitive measuring instruments with a sensitivity of ± 1 μm.

• Track Change Method

A trace of the specific geometry is made to the friction surface of the part subjected to abrasion by plastic deformation method. During experiments the amount of change in the dimension of the trace is measured. Brinell or Vickers hardness gauges are the most commonly used instruments for scoring. Changes in the traces left by the diamond or diamond tip are determined by measuring them through microscopes [3].

Material and Method

In this study, a compressor capable of producing a maximum pressure of 10 bar was used as the main power source. A conditioner is used in the system to prepare the required

air. Double acting cylinders with a diameter of 30 mm and a stroke of 120 mm were used to make the opening and closing movement of the window arm. For direction control, pneumatic valves with 5/2 pneumatic control and 2/2 magnetic sensing are used. Two throttle valves are used for system speed adjustment. A digital counter is used for the number of revolutions of the system. CHIN SPEC HP-200 color reader for measuring color change of the abraded material and PRECISA-XB620M sensitive scale for weight change are used. The precision scale is given in figure 1.1 and the color measuring device in figure 1.2. For the materials to be tested, a pvc cut open / close mechanism has been installed and a test setup has been prepared. The schematic picture of the spaniel mechanism is given in figure 1.3.

Figure 1.1. *Precision scale*

Figure 1.2. *Color measurement device*

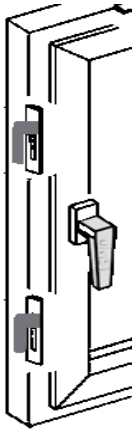

Figure 1.3. *Espagnolette mechanism*

In this test setup, the aim of the pvc arm is to establish a test setup to automatically determine the lifetime of the espagnolette counter by automatically turning it on and off. It is desired to open and close by double acting pneumatic piston. First, the air from the compressor is fixed to 8 bar in the air conditioner, and its damp is removed and is lubricated and is made suitable to be used in the pneumatic system. The appropriate air from the conditioner is transferred to the distributor and transferred to the places where extra air is needed.

The link is made as a rotary joint to translate the linear motion of the piston into the circular motion of the pin arm. In this case, the opening arm is provided to move 900 degrees. The front view of the test setup is shown in figure 1.4. The pneumatic circuit diagram of the prepared system is shown in figure 1.5 te. The test setup is designed to automatically perform repetitive movements.

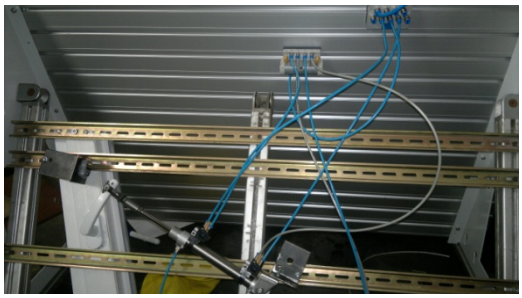

Figure 1.4. *Test Unit*

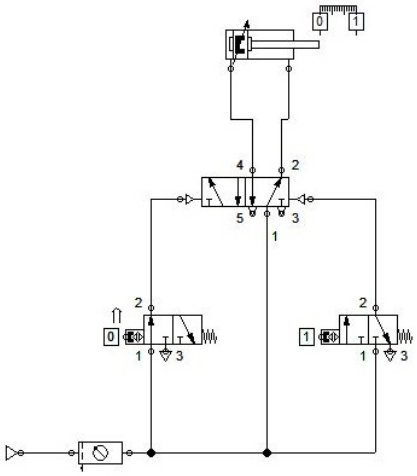

Figure 1.5 *Pneumatic Circuit Diagram*

Before starting the tests, espagnolette countermeasures are measured separately in terms of weight and color values. The prepared pvc mechanism was operated to open and close 1000 times and at this value the system was stopped and the weight and color measurements for the espagnolette were removed. After the measurement, the mechanism was reconnected and again turned on and off 1000 times. Repeat measurements were taken. In this way, the system was operated 10,000 times and 10 measurements were taken. For this study, 2 measurements were made.

Conclusions And Proposals

Friction occurred between the espagnolette and the counterpart as the test setup was run. Due to this friction, abrasion has occurred in the mechanism and sawdust has been observed. The chip spills are shown in figure 1.6 te.

Figure 1.6. *Chip particles*

A visible deformation has occurred due to the erosion on the anticlinal counterpart. The deformation of the trapezoidal counterpart is shown in figure 1.7.

Figure 1.7. *Worn espagnolette counter*

As a result of the tests, weight and color changes in the material were evaluated graphically. When the first sample is run 10,000 times, the color change is shown in Figure 1.8 and the weight change is shown in Figure 1.9. If the second sample runs 10,000 times, the color change is shown in Figure 1.10 and the weight change is shown in Figure 1.11.

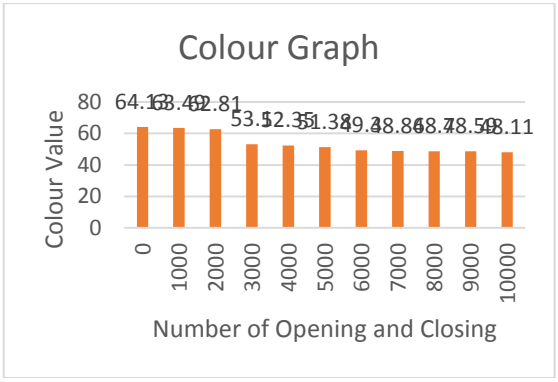

Figure 1.8. *First sample color change*

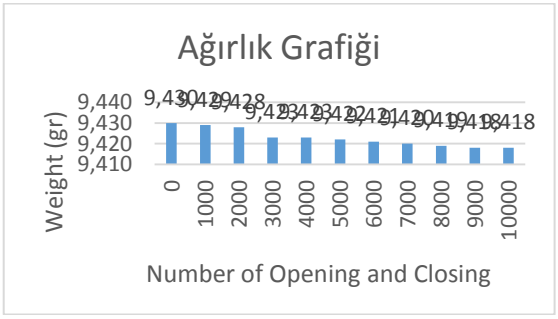

Figure 1.9. *First sample weight change*

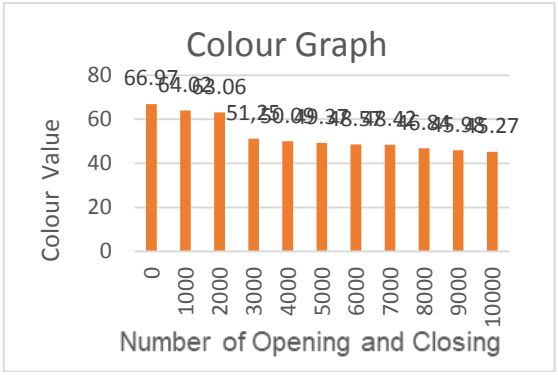

Figure 1.10. *Second sample color change chart*

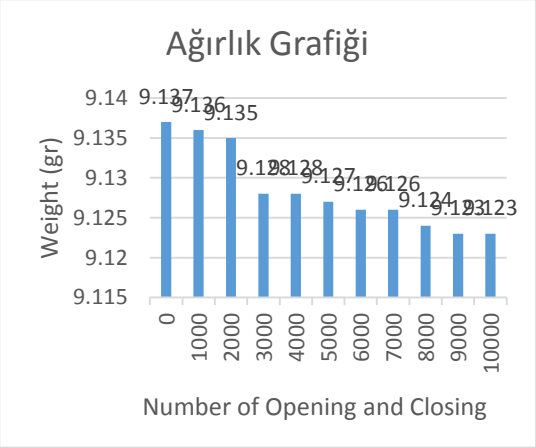

Figure 1.11. *Second sample weight change graph*

In life test result as can be seen in the graphs above, the brightness value of the first recurrence has decreased from 64,13 to 48,11 after the opening and closing of the window arm with the pneumatic system 10 000 times. The weight value of the spoilage counter was 9,423 grams at 9,430 grams, while it decreased to 9,418 grams after 10,000 openings.

With the new espagnolette counterpart and the second 10 000 recurrence, the gloss value of the material has decreased from the value of 66.97 to 45.27. The weight decreased from 9,137 grams to 9,123 grams. A significant decrease in the second recurrence was observed after 3000 piston opening / closing values.

As a result of these repetitions, it has been observed that the same type of 2 espagnolette counterparts give similar results in weight and brightness. As evidenced by the experiments, the coating material on the espagnolette countermeasure is protective. During the first 3000 open-close, the material showed resistance to abrasion, later on the material was seriously worn out. The wear and tear on the material prevents the mechanism from working properly. Failure to properly operate these types of lock mechanisms can lead to loss of isolation, as well as loss of comfort and safety, primarily in the system. As it is clear from the tests, the more durable coating on the material can seriously extend its life.

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