BEHAVIOUR OF ABRASSIVE MATERIALS USED IN PNEUMATICS RESPECT TO HIGH TEMPERATURE

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Abstract

Pneumatics is one of the most used systems in these days. Today equipment and system use this type of actuating because it is a very safe, economic and ease to implement. Another advantage that recommends this type of actuating is the reduced loss of heat during the actuating process. Material handling systems are characterised by repetitive movements, speed and displacement control and precision, requirements that recommend pneumatics driving. Implementing optimal control in a pneumatic driven system is not a very cheap or easy process. The control subsystem of a pneumatic driven system has to distinctive direction: the control from pneumatic point of view and the control from automatic point of view. The present study offer a cheaper solution to choose an optimal control and command system from both perspectives.

Keywords: *pneumatics, material handling.*

Introduction

The operating rate of workstations corresponds to the production rate of the plant. This basic principle of automated mass production has shaped the appearance of modern factories: a continuous flow of products that moves as if by magic from one station to the next, before being despatched at the end of the production process. A wide range of industrial applications require substances, objects, or components to be moved from one location to another. A further typical requirement is the application of a force to locate, hold, shape, or compresses a component or material. These tasks can be achieved using a prime mover, with rotary motion being provided, for example by an electric motor and linear motion by screw jacks, rack and pinions, and solenoids. Liquids and gases can also be used to convey energy from one location to another and as a result produce rotary and linear motions and apply forces. Fluid based systems using a liquid as the transmission media are known as hydraulic, and those using a gas are known as pneumatic.

Literature review

Hongwei Zhang (2021). Many scientists have researched mathematical modelling for OH processes in recent years, but no comprehensive simulations of OH have been developed to allow for model-based management of these events. In this study, we introduce, analyse, and investigate a mathematical model of a Colinear Ohmic Heater. We provide a mathematical description of the equations and suggest a potential numerical solution. So, we use MATLAB/Simulink to create a model and then check it against the data. The simulations demonstrate that the MATLAB/Simulink model may provide very accurate results (up to 99.6%) with tolerable levels of computing overhead. The OH processes may be studied using this model, and intricate controls can be developed.

George E. Klinzing (2018) This document attempts to cover the development of pneumatic conveying over the past 100 years or so. The individual researchers who worked in the field are highlighted along with their photograph which is included at the end of the document. As time progressed in the scientific and engineering developments of these years one see a transition from a purely experimental approach with considerable empiricism to adapt to the development of numerical procedures in attempt to predict the low characteristics. The basic physics of the phenomena of pneumatic still is not completely understood and new and novel experimental techniques are always welcome in the field.

Developments in Pneumatic Equipment

When working with iron and other metals, early smelters and blacksmiths relied on hand bellows, a primitive kind of air compression. Several flaps, functioning as valves, are fastened to an air intake panel made of wood. On the suction stroke, air cannot be sucked back into the bellows because of a simple check valve in the outlet. A rudimentary jet-type compressor supplied air for smelting and forging in the 1st century AD, during the reign of Hero. In the 17th century, German scientist Otto von Guericke led the way in experimentally improving compressor design. Air was compressed in a series of cylinders using a stage or compound compressor, which was created in 1829. Since at least 1872, when water jets were first used to cool compressed cylinders, there have been efforts to increase cooling in the form of water-jacketed cylinders. The house tunnel in North Adams, Massachusetts was the first major U.S. construction project to employ a four-cylinder compressor in 1866.

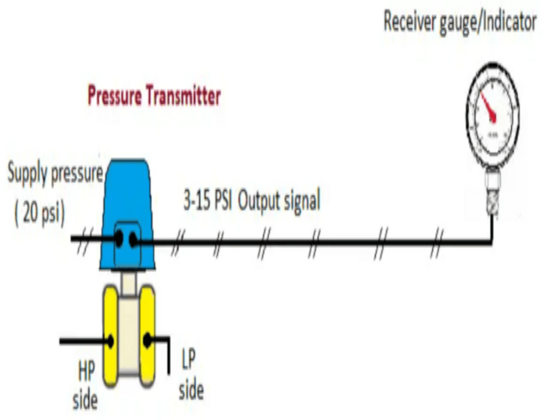
Typical Examples of Pneumatic Tools

Pneumatic tools and air compressors are two examples of common pneumatic equipment. From paint sprayers and pneumatic tubes for shipping to railway brakes, compressed air is employed in a broad range of tools and machinery.

A device that uses an external energy source to increase the air's pressure above atmospheric pressure is known as an air compressor. Fluid devices, such as compressors, may be loosely classified into two groups based on the kind of air or fluid action they employ: the positive-displacement type, and the velocity, or dynamic, type.

Pressure Variability in a Pneumatic System

The gauge serves as an indication and may measure pressure from 3 to 15 psi. The process measurement scale ranges from 3 psi (the signal low end) to 15 psi (the signal high end). The transmitter calibration is typically performed between 0 and 300 PSI. No pressure is indicated by the transmitter's output of 3 PSI. The transmitter's output is 15 PSI at maximum process pressure (300 PSI). The pressure gauge also gives the same reading.



If expressed as a percentage, a signal pressure of 3 psi would be 0% while a signal pressure of 15 psi would be 100%. The linear range of pneumatic signals produced by pneumatic transmitters is 0-100%, with the range spanning from 3 to 15 psi (pounds per square inch).

Output signal	Output in %
3 PSI	0%
6 PSI	25 %
9 PSI	50 %
12 PSI	75%
15 PSI	100 %

Pneumatic pressure is typically between 0.21 and 1.50 kg/cm2, or between 3 and 15 psi (one pound per square inch, or psi, is equal to 0.07 kg/cm2).

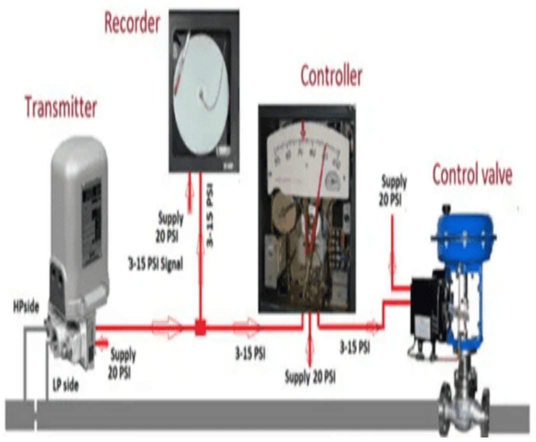


Figure 1: Pneumatic Flow control loop

Pneumatic systems are superior than electric actuators and motors when used for linear and rotating motion.

Pneumatic systems generate less force than hydraulic systems, and since air is so easily compressed, pneumatics can absorb excessive stress, making them well suited to lighter loads.

Precautions

To prevent pipe failures, we need to keep a close eye out for air leaks and corrosion.

To function properly, the compressed air must be of sufficient purity.

Pneumatics relies heavily on properly prepared air. As a result, there has to be a means of dispelling moisture, dirt, and grease. Otherwise, parts like valves and seals might get clogged or corroded.

The pneumatic system's integrity may be guaranteed by the installation of a filter system and the subsequent monitoring of the air supply.

Pneumatic system drawbacks, section

Pneumatic components are very vulnerable to shaking. As a result, the installation site must be far from any potential vibrations.

• It requires more work to be ready for use (drying out and filtering out contaminants) than other energy sources.

• Its labor force is small. (In latitudes between 20 and 30,000 North).

• It makes a lot of noise since air escapes after usage.

Good performance and simple installation may help mitigate the high cost of this energy source.

Inside the panel, the pneumatic system's tubing, indicators, recorders, controllers, square root extractors, and air headers take up a tone of room. In contrast, control panels that use electronic instruments are not bulky and have few potential points of failure in terms of wiring.

High Stress Abrasion Analysis

Results of two-body high stress test conditions on six monolithic materials and WC-Co coatings (prepared with JK112 and WOKA powders, at 45 psi chamber pressure) are shown in Figure 2. The only variable between groups was the amount of force applied, while sliding speed and wear route were maintained constant.

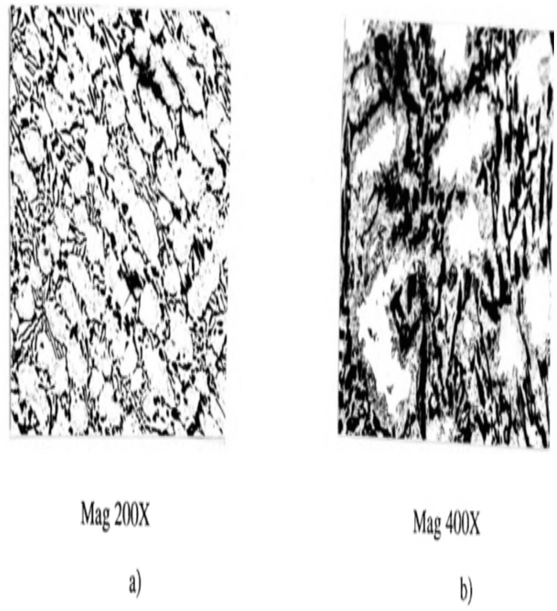


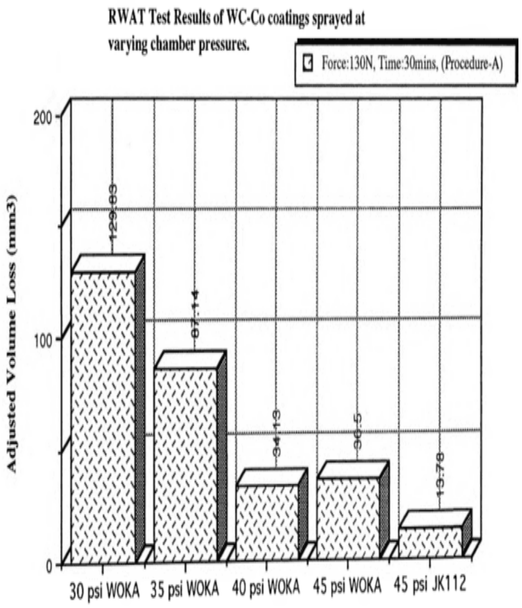
Figure 2: 28% Cr (as cast) iron

Effect of Applied Load

At 50mm sliding speed and 6m wear path with loads ranging from ION to 50N, the relationship is shown in Figure 5.10 for SiC abrasive. Iron with 28% chromium (heat treated) lost the least amount of mass. Nonlinearity was observed for all materials under ION stress, and it was determined that the mass loss of SG iron-E was greater than SG iron-I. The mass loss of WC-Co coatings produced using the JK112 source was lower than that of coatings produced using the WOKA source

Effect of Chamber Pressure on the coating

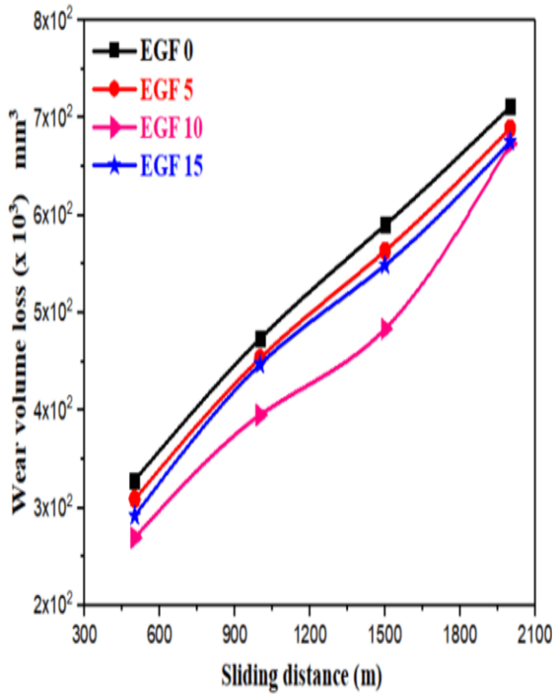
Five coatings were produced by varying the chamber pressures, and low stress abrasive wear was accomplished using procedure-A. The outcomes of abrasion tests conducted on the coatings. The JK112 coating, applied at 45 psi, showed excellent resistance to wear. Among the coatings produced with the WOKA source, the one sprayed at 40 psi had the highest abrasion resistance. Coatings sprayed at 30 and 35 psi saw the most adjusted volume loss and considerable wear at the conclusion of the test.



Three-Sided Abrasive Wear Analysis of Composites

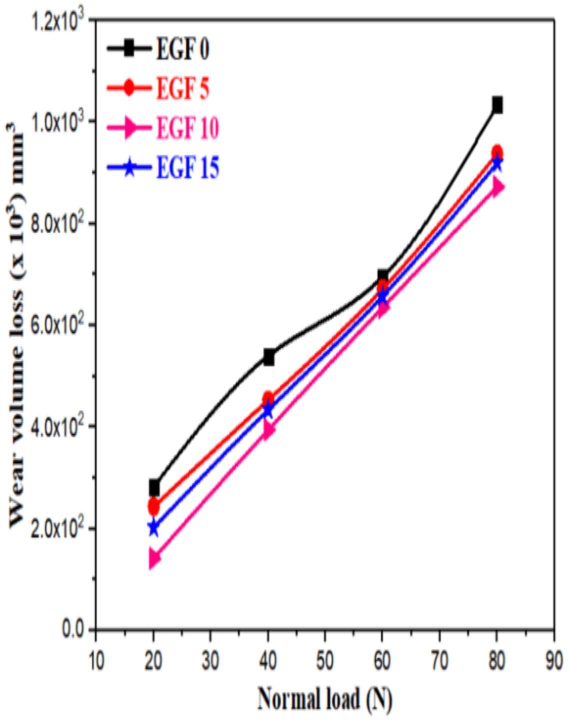
In the real world, rummage sales are where you may get rough clothes and gear used in agriculture and mining. Here, we'll talk about how long those polymer composites last that we mentioned in the procedure. This study employs a novel filler material comprised of fly ash and chemosphere to enhance the durability of fibres (Glass and Basalt) in an epoxy matrix. In this chapter, we provide the findings of a comprehensive study of the effects of altering the sliding distance and normal load on steady-state experimental runs using unfilled and particulate-filled fibre reinforced epoxy composites. We also compare the relative importance of the various elements impacting the abrasive wear rate in dry sand conditions using an orthogonal array. The abrasion resistance of glass-epoxy composites (EGF) with and without fly ash was evaluated.

The effect of sliding distance on wear volume loss and abrasive wear rate for steady state three-body abrasive wear behaviour. Glass fibre reinforced plastic (GFRP) composites loaded with fly ash (0, 5, 10, and 15% wt.%) undergo a dry sand abrasion test to determine the volume loss and abrasive wear rate. Under the same conditions of sliding velocity = 200 RPM (2.387 m/s), normal load = 40 N, and abrasive size = 300 m, the wear volume loss and abrasive wear rate of GFRP composites containing different percentages of fly ash over sliding distances of 500 m, 1000 m, 1500 m, and 2000 m. Wear on a composite material is shown as a function of sliding distance in Figure 1. Regardless of filler (fly ash) proportions, wear volume loss of composites rises with increasing sliding distance. Volume loss was 3.286 102 mm3 after 500 m and 6.737 102 mm3 after 2000 m for the unfilled (EGF-0) composite and 2.695 102 mm3 and 6.737 102 mm3, respectively, for the composite loaded with 10 wt.% fly ash (EGF-10). This is so because the fly ash filler prevents the epoxy matrix from bending. Wear volume loss of a GFRP composite loaded with 15% fly ash does not reduce with increasing sliding distance.



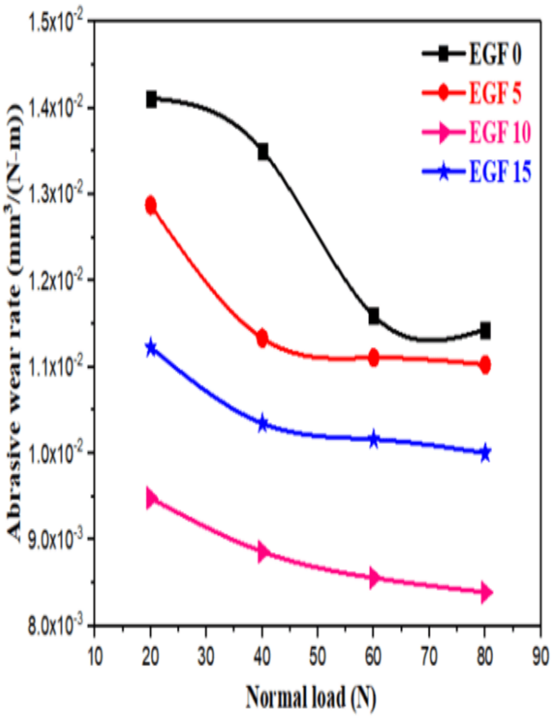
Graph 1: Volume loss due to wear in composite parts

Graph 1 demonstrates how the sliding distance impacts the abrasive wear rate of composites. The composites are more resilient when slid between 500 and 2000 meters. Epoxy-glass-fly ash (EGF 10) composite had the lowest wear rates of the evaluated materials, with values from 1.34 102 mm3/Nm (at 500 m) to 8.12 103 mm3/Nm (at 2000 m). The hard surface formed by the fly ash loading reduces the wear rate of the composite. The first time the epoxy matrix comes into contact with the considerably harder angular silica sand is during the three-body abrasive wear process. So far, a great deal of energy and material has been squandered. As the fiber and fly ash filler are distributed farther from the silica sand particles, the material's abrasion resistance improves. The fire or particle reinforcement under the epoxy matrix was exposed due to abrasion. It took a lot more energy for abrasive particles to produce fiber/filler failure at increasing abrasion distances. Consequently, the rate at which material is removed decreases with increasing abrading distances.



Graph 2: Wear volume in composites under typical loading conditions

Graph 2 depicts the wear rates of composites under typical loads (20, 40, 60, and 80 N). It has been shown that progressive increases in normal load may minimize wear. Increasing the amount of fly ash in composites has been found to improve both their strength and durability. When fly ash is utilised as a reinforcing material, the amount of abrasive wear is substantially decreased because the particles of fly ash rub up against the particles of silica sand rubber tire during three-body abrasion. By increasing the surface hardness of the composite, fly ash helps the reinforcing matrix adhere to it more strongly, which in turn delays failure. Wear rates are not decreased by using more fly ash filler due to the larger voids in the composite and the weaker bonding between the matrix and reinforcement.



Graph 3: Abrasion resistance of composites in comparison to normal loads

Conclusion

When exposed to high temperatures, the performance and durability of abrasive materials used in pneumatics can be significantly affected. Abrasive materials such as sand, grit, or other particles can undergo changes in their physical properties, leading to potential issues in pneumatic systems. Material Degradation: High temperatures can cause abrasive materials to undergo thermal degradation, leading to changes in their composition and structure. This degradation can result in reduced hardness, increased brittleness, or loss of abrasive properties altogether. Wear and Erosion: In high-temperature environments, abrasive materials may experience accelerated wear and erosion. The combination of elevated temperatures and abrasive particles can lead to increased friction, surface damage, and erosion of critical pneumatic components. High temperatures can also pose safety hazards when using abrasive materials in pneumatics. The generation of excessive heat can increase the risk of fire or explosion, especially if flammable or combustible substances are present in the vicinity of the abrasive materials.

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