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INFLUENCE OF GASEOUS MEDIA ON DAMPING OF PNEUMATIC COUPLINGS

Summary. In our department has long been devoted specifically flexible pneumatic shaft couplings. These couplings are filled with a gaseous medium air. Examination, we found that the type of gas, its properties such as gas density, compressibility factor, molecular weight and viscosity alter dynamic properties pneumatic coupling. The main objective of this article is to determine how various gaseous media influences damping coefficient *b*. The article compares three different gases, air, helium and propane-butane. These gases have different properties and it can change damping coefficient *b*. The measurements are performed in the laboratories of our department in Košice. We used flexible one-bellow pneumatic coupling *4-1/70-T-C* and two-bellows pneumatic coupling *4-2/70-T-C*. Pressure gaseous medium was varied in the range of *100* to *600kPa*.

Keywords: flexible pneumatic coupling, gas, air, helium, propane-butane, one-bellow, two-bellows, damping, experimental measurements

WPŁYW MEDIUM GAZOWEGO NA TŁUMIENIE SPRZĘGIEŁ PNEUMATYCZNYCH

Streszczenie. W zakładzie Projektowania i Części Maszyn Wydziału Mechanicznego Uniwersytetu Technicznego w Koszycach już od wielu lat prowadzone są badania dotyczące sprzęgieł, a w szczególności pneumatycznych sprzęgieł podatnych. Do tej pory sprzęgła te były napełniane powietrzem. W wyniku badań okazało się jednak, że ten gaz, a w szczególności jego właściwości zmieniają właściwości dynamiczne sprzęgieł pneumatycznych. Głównym celem niniejszego artykułu jest określenie wpływu różnych mediów gazowych na współczynnik tłumienia sprzęgła *b*. Porównano wpływ trzech różnych gazów: powietrza, helu i propanu-butanu. Gazy te mają różne właściwości i w ten sposób wpływają na zmianę współczynnik tłumienia sprzęgła *b*. Pomiary zostały wykonane w laboratoriach Zakładu, którego pracownikiem jest autor niniejszego artykułu. Wykorzystano sprzęgło pneumatyczne z mieszkami jednowarstwowymi *4-1/70-T-C a* i sprzęgło z mieszkami dwuwarstwowymi *4-2/70-T-C*.

Słowa kluczowe: elastyczne sprzęgła, gaz, mieszek jednowarstwowy, mieszek dwuwarstwowe, hel, propan-butan, współczynnik tłumienia

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1. INTRODUCTION

According to the many authors [1, 2, 3, 4, 5, 6], the most appropriate solution of dangerous torsion vibration capturing is appliance of adequate flexible pneumatic coupling. Mastering this dangerous torsional vibrations can greatly reduce respectively eliminate negative impacts on the environment (vibration, noise) and at the same time protect the individual parts of machinery from mechanical damage. We still have perform these couplings gaseous medium air. The gaseous medium has a significant influence on the elastic properties of the pneumatic coupling

The main objective of this article is to compare three different gases from a physical point of view and their influence on the dynamic characteristics of pneumatic shaft coupling. The article compares the different gases that have different physical properties. We explore flexible one-bellow pneumatic shaft coupling with marked *4-1/70-T-C* and flexible two-bellow pneumatic shaft coupling with marked *4-2/70-T-C.* Both couplings have been developed in our department.

2. RESEARCHED FLEXIBLE COUPLINGS AND GAS

When measured in laboratories, we used pneumatic flexible shaft couplings. Flexible couplings, except the transmission of torque, it should protect mechanical systems against torsion oscillation not only in a phase of starting and braking but also during the whole working mode. These couplings usually move radial frequency to the lower frequency such as zone of working operations. Significantly reduce the dynamic stress in the mechanical propulsion system. By its flexibility it is able to attenuate the burst of drive and thus protect particular parts against damage [7, 8, 13, 14].

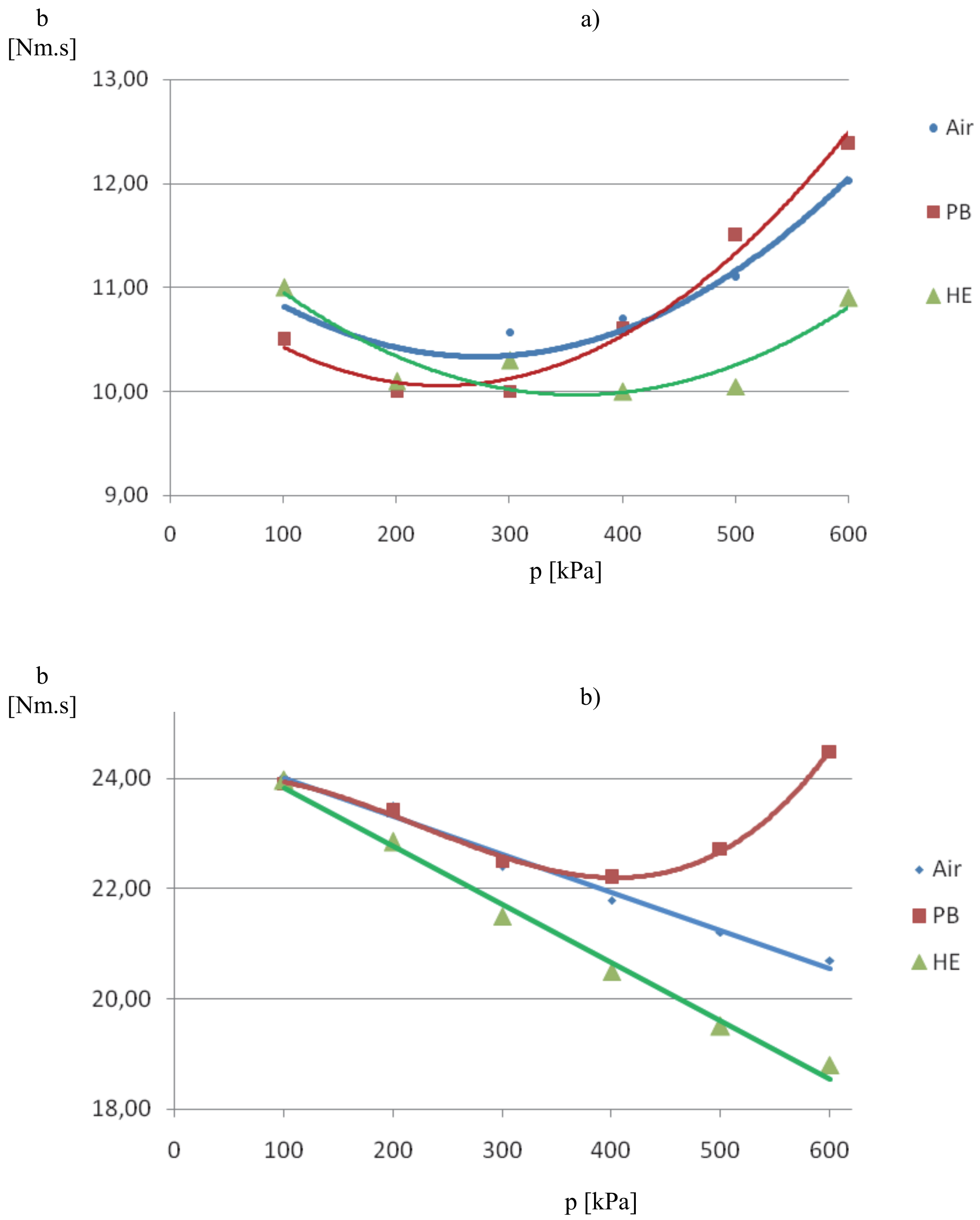
Flexible one-bellow pneumatic coupling *4-1/70-T-C* and flexible two-bellows pneumatic coupling 4-2/70-T-C we successively perform three different gases and carried them to dynamic measurements. For measurement, we decided to use air, helium and gas mixture of propane and butane.

3. DAMPING COEFFICIENT

These measurements were performed in the laboratories of our department free oscillation. By this method, we found the value of the damping coefficient value [6]. Within a few tens of measurements, we had about *96 570* values which we then successively evaluated.

Dynamic measurements are performed for the gases helium, air and propane-butane gas pressures ranging from *100* to *600kPa* since we were limited to a maximum pressure in the cylinder of propane-butane.

Value of the damping coefficient b varies with the pressure in the pneumatic coupling and gas such as pressurized (Fig.1). One-bellow coupling has a value in the range of *10 Nm.s* to *12,3Nm.s* for pressures in the range of *100* to *600kPa*. Two-bellows coupling has a value in the range of *24,5 Nm.s* to *18,8Nm.s* for pressures in the range of *100* to *600kPa*. Coupling filled with helium reaches the smallest value damping than one-bellow so well in two-bellows coupling. Effect of propane-butane is starting to show up from *300-400 kPa* pressure when the coupling achieves the greatest value of damping.



Rys. 1. Wartości współczynnika tłumienia *b* dla sprzęgła napełnionego helem, powietrzem oraz propanem-butanem w zależności od ciśnienia *p*

Fig. 1. The values of the damping coefficient *b* for coupling and filled with helium, air and propane-butane on the pressure *p*

4. CONCLUSION

Objective of Article was to evaluate the influence of different gas damping coefficient *b*. The pneumatic coupling is gaseous medium a significant effect on the mechanical properties of coupling and thus the entire mechanical system. In our case, we compared three different gases helium, air and propane-butane. These gases were used in the one-bellow and two-bellows flexible pneumatic shaft coupling.

After performing the measurement and evaluation, we can state the following conclusions.

Pressure gaseous medium was varied in the range of *100* to *600kPa*. One-bellow coupling has a value in the range of *10 Nm.s* to *12,3Nm.s* for pressures in the range of *100* to *600kPa*. Two-bellows coupling has a value in the range of *24,5 Nm.s* to *18,8 Nm.s* for pressures in the range of *100* to *600kPa*. We conclude that the coupling are filled with air achieves similar damping coefficient values as coupling filled with propane in the low pressure (up to 300kPa). In the area of higher pressure reaches higher values damping coefficient coupling filled with propane-butane gas. This also valid to one-bellows coupling and two-bellows coupling. Coupling filled with helium reach lower values damping coefficient and significant changes can be observed in the high pressure of 300kPa. Helium is the lightest technical gases. One-bellows coupling with smaller values damping coefficient as two-bellows coupling. In conclusion, I can say that the type of gas we change the properties of couplings but not so much if you design such as the number of couplings bellows.

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