10th International Research/Expert Conference
”Trends in the Development of Machinery and Associated Technology”
TMT 2006, Barcelona-Lloret de Mar, Spain, 11-15 September, 2006

THE EXPERIMENTAL EFFECTS OF THE FRICTION TO THE SONIC FLOW IN THE CASE OF THE SYSTEM FORMED WITH ONE CAPACITY CYLINDER AND ONE FRICTION RESISTANCE

Carmen Bal
Technical Universty Cluj Napoca
Street Daicoviciu, nr. 15, Cluj Napoca
Romania

ABSTRACT
In the paper we present the effect of the friction used the pressure sonic and the sonic flow by one installation. This installation is formed by one cylinder and one resistance of frictions. The effects makes in this case are the effects caloric show by the upper of the temperature in the friction resistance.
Keywords: sonic pressure, temperature**,** friction coefficient, sonic instalation

1. GENERAL NOTIONS
Sonicity is the science of transmitting mechanical energy through vibrations. Starting from the theory of the musical accords, Gogu Constantinescu found the laws for transmitting the mechanical power to the distance through oscillations that propagate in continuous environments (liquid or solid) due to their elasticity. At the Romanian Academy conference of the 14th of November 1919, Gogu Constantinescu presented the multiple functioning of the sonicity in transports, energetics and petroleum drillings.
The laws used in sonicity are the same with the laws used in electricity. Gogu Constantinescu founded the theory of the sonicity and made the sonic engine.

1.1 Sonicity parameters
If have sinusoidal flow, we have the relation:

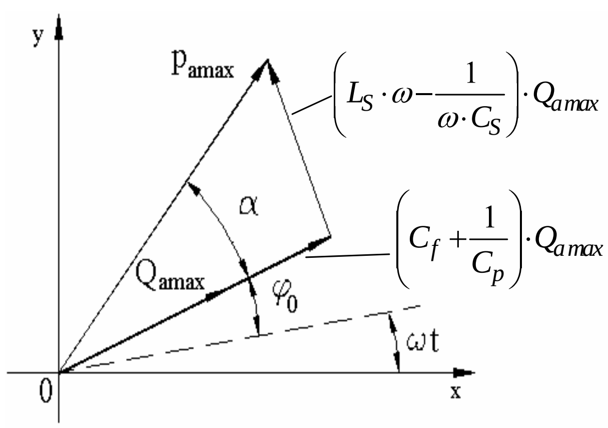

Figure 1. The vector diagram of the sonic flow

$$Q_i = C_p \cdot p_{Si|p} \qquad (1)$$

were C_p is the coefficient of the perditanta, result the $p_{Si|p}$ will be sinusoidal formed and in phases with the sonic pressure we can writing:

$$Q_{a\max} = C_p \cdot p_{a\max} \qquad (2)$$

Friction. For the friction we have the relation:

$$p_{a\max} = C_f \cdot Q_{a\max} \qquad (3)$$

is in phases with the flow, figure 1, were $R_f = C_f$, define the friction coefficient.

By the vector diagram, we observe the modulus of the $p_{a\max}$

can be:

$$p_{a\max} = Q_{a\max}\sqrt{\left(C_f + \frac{1}{C_p}\right)^2 + \left(\omega \cdot L_S - \frac{1}{\omega \cdot C_S}\right)^2} \tag{4}$$

the vector $\vec{p}_{a\max}$, can be advanced with the $\vec{Q}_{a\max}$ vector, with the α angle, give by relation:

$$tg\,\alpha = \frac{\omega \cdot L_S - \dfrac{1}{\omega \cdot C_S}}{C_f + \dfrac{1}{C_p}} \tag{5}$$

With $\alpha = 0$, we have:

$$L_S \cdot C_S \cdot \omega^2 = 1 \tag{6}$$

This condition suit a situation of resonance between capacity and inertia.

The capacity $L_S \cdot \omega - \dfrac{1}{C_S \cdot \omega}$, are name *reactance*, have the same dimension with the friction coefficient, but are differenced to friction because the sonic pressure of the friction resistance are in phases with the revolution. Whereas the sonic pressure due to one reactance, are deferent phases with 90^0 against the flow.

In the same mode we can see the friction coefficient C_f, as symbolic inertia, while *perditanta,* as symbolic capacity, for example the value of the equivalent inertia for a C_f resistance, can be distinguish:

$$p_{Si_{|f}} = p_{Si_{|L}} \qquad C_f \cdot Q_{a\max} = j \cdot \omega \cdot L_S \cdot Q_{a\max} \tag{7}$$

2. THE EXPERIMENTAL EFFECTS OF THE FRICTION TO THE SONIC FLOW

We considered the sonic system formed by with one capacity cylinder and one friction resistance (figure 2). Is formed by sonic generators who are connecting by the friction resistance R_f. with a pipe, this resistance is connected also by a pipe to the capacity cylinder. The capacity of cylinder are V= $2405{,}282 \cdot 10^3$ mm^3.

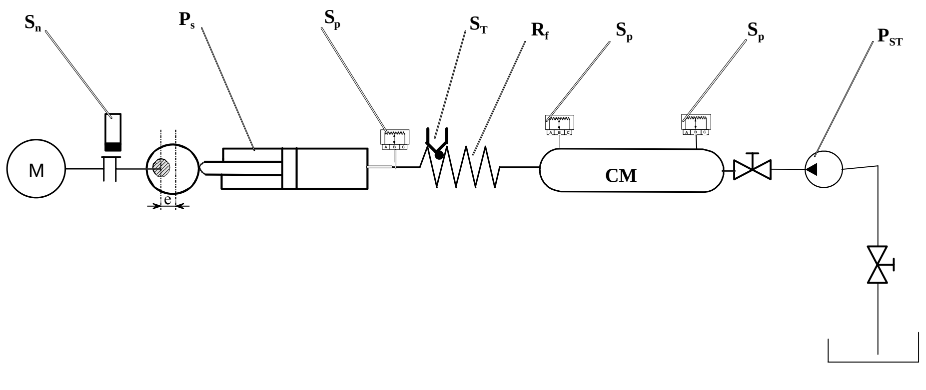

Figure 2. The experimental sonic system with one capacity cylinder and one friction resistance

In the experimental graphics we are noted with:

ΔG – the variation of the generator pressure;

ΔS_1 – the variation of the pressure obtained by the first sensor of pressure place to the la left of the capacity cylinder;

ΔS_2 – the variation of the pressure obtained by the right sensor of pressure placed to the capacity cylinder;

T – temperature.

For make in evidence the effects of the friction we can study the effects of the sonic pressure in the system. For this we can have charge the system with static pressure. For same static pressure (0,25bar, 0,5bar) we obtained the diagrams for this charges.

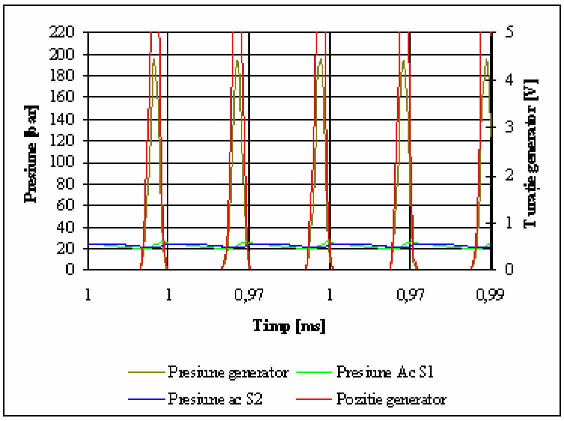

Figure 3. The evolution of the pressure in time for the system with on cylinder capacity

After the work of the experimental dates obtained from the three sensor place in the system, are results the primary histograms represented in the figure 3, this show the evolution of the generator pressure and also the pressure to the extremity of the capacity cylinder. Also we can see the revolution of the generator. The evolution of the pressure curve to notice the existence the phases difference by the generator pressure and the pressure of the capacity cylinder.

The diagrams presents in the figure 4 and 5 are realized for a 0,25 bar static pressure, and 1667 r.p.m. The temperatures realized in the installation about 60 seconds to work are 75°C.

n = 1667 rot/min **p_s = 0,25E+05 Pa**

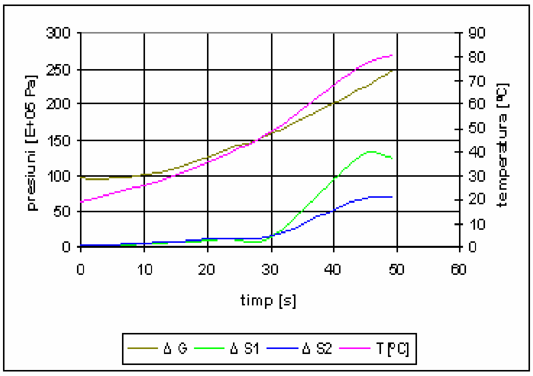

Figure 4 The variation of the pressure and the temperature in time to 0,25E+05 Pa static pressure

p_s = 0,25E+05 Pa

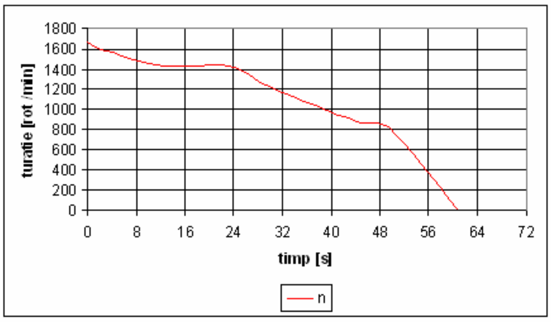

Figure 5 The variation of revolution in time for the static pressure to 0,25E+05 Pa

The pressure received by the pressure sensors assembling by cylinder are register in time to 30 seconds, same pressure, after the sensor assembling to the front of the friction resistance are register the upper of the pressure, the difference of them are 50E+05 P . The difference between sensors that mark the fall down of the pressure (by generator and the front of the cylinder place in continued to the friction resistance) to reach to 120 E+05 Pa. Because of appeared this big pressure in the installation, the electric motor are stopped.

After the analyzing of the diagrams we can draw the **conclusions**:

- the big influence to upper of the pressure also of the temperature in the installation are the revolution, thus when to the start are upper so much rapidly upper the pressure ant the temperature of the friction resistance;
- the static pressure by installation not influence the upper of the temperature realized;
- if the electric motor are stopped after a short period of time, we not recommended the construction of the installation formed by one friction resistance and one cylinder;
- the stopped of the electric motor are because the total volume (V_{tot}), of the fluids in the circuit are upper when the minimal volume used for the good function of installations (V_c). The pressure in the installations can be little when the pressure imposes. In this case the volume of fluids can be taking by the compressibility of the volume yield by the generator.

3. THE CALCULUS OF THE VOLUME OF FLUIDS TAKING BY THE COMPRESSIBILITY OF THE VOLUME YIELD BY THE GENERATOR.

For the volume yield by the generator and for used in totality this column of fluids this volume must be one volume V_c,

$$V_c = V_g\left(\frac{E}{p} - 1\right) \tag{8}$$

For one pressure p = 100 bar ≈ 10 N/mm^2, D_p = 40 mm, l = 10 mm, $E_{(ulei)}$ = 1400 N/mm^2, the volume of oil yield by the generator are:

$$V_g = \frac{\pi \cdot D_p^2}{4} \cdot l = \frac{\pi \cdot 40^2}{4} \cdot 10 = 12566{,}37\ \text{mm}^3 \tag{9}$$

In this situation, the total volumes of fluids in the circuit (generator, pipe, frictions resistance and cylinder) are:

$$V_c = V_g\left(\frac{E}{p} - 1\right)' = 12566{,}37 \cdot \left(\frac{1400}{10} - 1\right) = 1746{,}725 \cdot 10^3\ \text{mm}^3 \tag{10}$$

4. REFERENCES

[1] Constantinesco, G., Theory of Sonics: A Treatise on Transmission of Power by Vibrations, The Admiralty, London, 1918.
[2] Constantinescu, G., Teoria sonicității, Editura Academiei R.S.R., Bucureşti , 1985.
[3] Pop, I., Marcu, I. L., Personalități în ştiință şi tehnică - Gogu Constantinescu, Editura AGIR, Bucureşti, 2004.
[4] Pop, I., Tratat de teoria sonicității, manuscris în curs de editare.
[5] Popa, Bazil, s.a., Manualul inginerului termotehnician, vol. I, Ed.Tehnică, Bucureşti, 1986.
[6] Constantinesco, G., Haddon, W., Transmission of impulsive forces through liquids, patent no. 182206/1920.
[7] Constantinesco, G., Haddon, W., Liquid wave transmission, patent no. 132027/1920.
[8] Constantinesco, G., Haddon, W., Hydraulic power transmission, patent no. 24231/1920.