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CONTRIBUTION TO THE EXPERIMENTAL STUDY OF BORE GAS EVACUATION DEVICE ON THE HIGH PRESSURE BARRELS

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Abstract: *The paper presents the experimental approach of the functioning assessment for the bore gas evacuation device embedded on the high pressure barrels with special destinations. The experimental measurements and numerical calculus in terms of resistance materials were conducted in order to find the normal mechanical stress in some components parts belonging to bore gas evacuation device.Consequently in order to ensure the operational and safety efficiency of the high pressure barrels with special destinations the present research could contribute at the problem of solving of an increased number of requirements with reduced resources.*
Key words: *Bore gas evacuation, thermal expansion, high pressure barrels.*

1. INTRODUCTION

According to the specialised standards provisions the bore gas evacuation device is the device which enable the evacuation of the gas from the high pressure barrel channel in the bore gas resevoir. After a short period of time the gas stocked in the reservoir will be ejected in the atmosphere in the direction of the muzzle barrel. [4]

As a result will be decreased the quantity of the burned gas from the interior of the specialised vehicles.

The bore gas evacuation device can be mounted at the muzzle high pressure barrel or at different distances from the muzzle barrel starting with the half to the 2/3 from the length of the barrel. The interior of the bore gas evacuation comunicate with the high pressure barrel channel through inclined holes at different angles in reference to the axis barrel as well as through holes drilled at 90^0 in reference to the axis barrel [5].

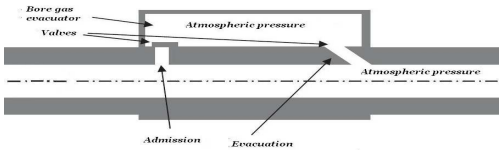

Fig. 1 A schematic functioning view of an bore gas evacuation device

2. EXPERIMENTAL AND NUMERICAL MODEL

The functioning of the bore gas evacuator depend on the proper functioning of the inlet valve. The inlet valve could have diferernt technical constructive solutions. For the current research was taken into consideration an inlet valve which consist in plunger rod, elastic damping elements and a ball.

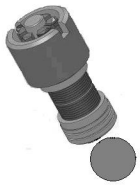

Fig. 2 A schematic view of the inlet valve components

The numerical calculus in terms of the resistance materials theory were conducted in order to asses the normal mechanical stress within the ball of the bore gas evacuation device.

During the functioning the ball of the bore gas evacuation device is exposed at compression due to the force induced by the gas pressure within the barrel. As well as the

ball suffer an thermal expansion due to the heat transfered by the burned gas. [3].

From resistance materials theory point of view the section of the ball being constant have the consequence that the dangerous section could be any section.[1]

In order to asses the normal mechanical stress within the ball of the bore gas evacuator device will be cumulated the effects of the compression and of the thermal expansion. The calculus formulas used are those recommended by the resistance materials theory.[1]

3. CASE STUDY

INPUT DATA

In the present study case will be applied the above presented method in order to analyze the normal mechanical stress within the ball of the bore gas evacuation device as well as to identify the different positioning variants of the bore gas evacuation device on the high pressure barrels.

During some functioning test of high pressure barrels where gathered the values of the barrel exterior surface temperature. For this was used a laser thermometer OPTRIS OPTLS SN 6080114.

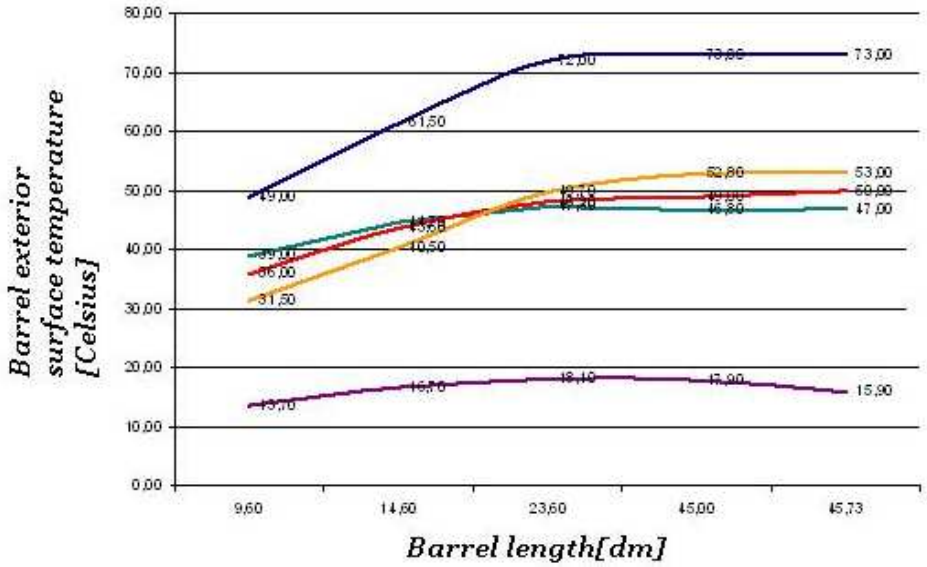

Fig. 3 Barrel exterior surface temperature

The graphical plot within Figure 3 emphasizes the followings:

- In the zone within the proximity of the muzzle of high pressure barrel the thermal effect induced by the dynamic of the gas is more intense in comparison with other zone belonging to the high pressure barrel;
- the thermal effect induced by the dynamic of the gas is in direct relationship with the level of continuous high pressure barrel usage.

The numerical calculus input data where:

- pressure variationn within the barrel for the most intense thermal and dynamic regime of the gas;
- dimensional characteristics of the bore gas evacuation device;
- the most stressed barrel zone, from thermal point of view, based on the experimental gathered data.

OUTPUT DATA

After the experimental data gathering and conducted calculus where obtained the followings (Figure 4):

- the variation of the normal mechanical stress within the ball of the bore gas evacuation device due to the force induced by the gas pressure within the barrel;
- the variation of the normal mechanical stress within the ball of the bore gas evacuation device due to the thermal effect;
- the variation of the total normal mecahnical stress within the ball of the bore gas evacuation device due to the cummulated effcets mebntioned above.

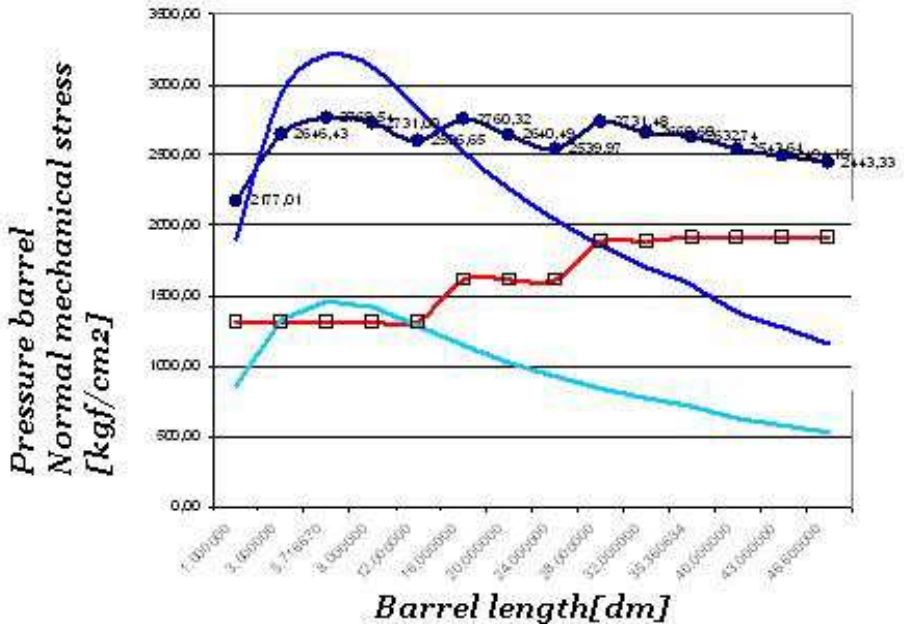

Fig. 4 Pressure and normal mechanical stress within the barrel

According to the data plotted within the Figure 4 can be concluded that alongside of the high pressure barrel exist three points where are recorded similar values of the total normal mechanical sterss within the ball of the bore gas evacuation device.

This is equivalent with the possibility to mount on the high presssure barrels in that particular positions the bore gas evacuation device. The idebntified positions are:

- Version 1: at muzzle of the barrel.
- Version 2: at half of the barrel;
- Version 3: at 1/3 from the barrel length measured from the bottom of the barrel.

The versions presented above are plotted within the Figure 5.

In this context we emphasize that on the majority of the modern specialised vehicles the bore gas evacuation device is mounted at aproximatelly half of the high pressure barrel or at 1/3 from the barrel length measured from the bottom of the barrel.

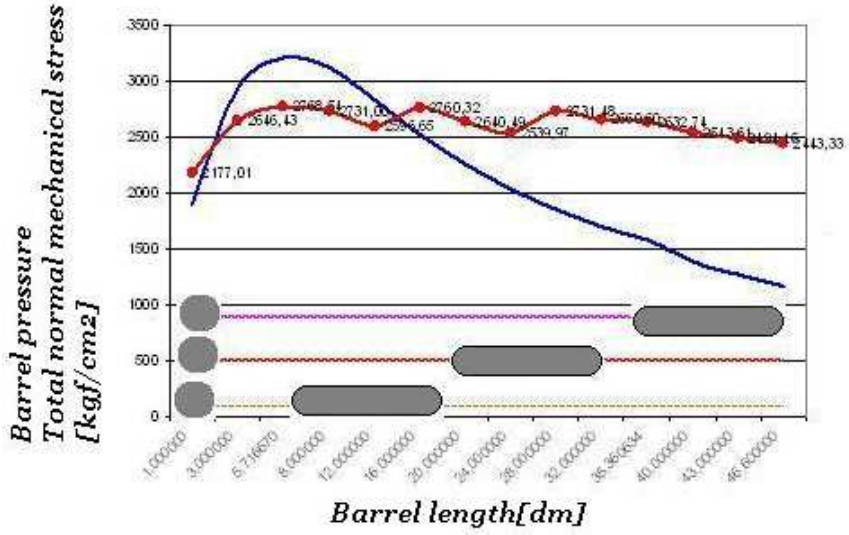

Fig. 5 Position of the bore gas evacuation device on the barrel

4. CONCLUSIONS

The proposed model can contribute at the assessment of the functional behavior of the bore gas evacuation device embedded on the high pressure barrels.

The results of the calculus example emphasizes the achievements of the presented method as follows:
- the cumulating of the mechanical stress effects and thermal stress effects which show the behavior bore gas evacuation device components is a genuine approach in the field of the high pressure barrels with special destination;
- the method enable to be established a data base in terms of dynamic behavior of bore gas evacuation device;
- the assessment and inspection of the bore gas evacuation device components conducted during the experimental tests where generate additional data in terms of the reliability of the above mentioned parts;
- in order to proper design the bore gas evacuation device the method can be enhanced by the usage of the dynamic simulation under different simulation systems like ANSYS or SIMULINK. In this manner can be obtained additional data regarding the dynamic behavior through parameters like speed or acceleration;
- the future research work can be focused on a thorough evaluation of the maintenance cost of the bore gas evacuation device based on the reliability and dynamic behavior data gathered through the experimental approach.

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CONTRIBUŢII LA STUDIUL EXPERIMENTAL AL EJECTOARELOR DE GAZ DE PE ŢEVI DE ÎNALTĂ PRESIUNE

Lucrarea prezintă o abordare experimentală a evaluării funcţionării ejectorului de gaze de pe ţevi de înaltă presiune cu destinaţii speciale. Măsurătorile experimentale şi calculele numerice din punct de vedere a teroriei rezistenţei materialelor au fost efectuate pentru a determina tensiunea mecanică normală în anumite piese componente ale ejectorului de gaze. În consecinţă prezenta lucrare de cercetare poate contribui la rezolvarea problemei cu un număr crescut de cerinţe în situaţia asigurării unor resurse limitate pentru a asigura eficienţa operaţională şi a siguranţei în exploatare a ejectoarelor de gaz de pe ţevile de înaltă presiune cu destinaţie specială.

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