University of Novi Sad, Faculty of Technical Sciences, Novi Sad, Serbia

The 12th International Conference

KOD 2024

Machine and Industrial Design in Mechanical Engineering

BOOK OF ABSTRACTS

ADEKO

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23 - 26 May 2024, Balatonfüred, Hungary

Foreword

Dear Ladies and Gentlemen, respectable Colleagues and Friends of KOD,

The 12th International Conference of Machine and Industrial Design in Mechanical Engineering - KOD 2024 is being organized by the Faculty of Technical Sciences, the University of Novi Sad from the 23rd till the 26th of May 2024 in Hotel Marina at Balatonfüred, Hungary.

The Conference Chair would like to extend special gratitude to the Editor of the Springer book series Mechanisms and Machine Science, Prof. Marco Ceccarelli, for supporting the Conference and giving the chance to all authors to publish a paper in an edition titled Machine and Industrial Design in Mechanical Engineering – Proceedings of KOD 2024.

The basic goal of this conference is to assemble experienced researchers and practitioners from universities, scientific institutes and different enterprises and organizations from within this field. Also, it should instigate more intensive cooperation and exchange of practical professional experiences in the field of shaping, forming and design in mechanical and graphical engineering, industrial design and shaping, product development and management. As there is a pressing need, under the cover of Industry 4.0, for more effective, simpler, smaller, cheaper, noiseless and more esthetically pleasing products that can easily be recycled and are not harmful to the environment, the cooperation between specialists in these fields should certainly be well developed and intricate.

Finally, we would like to thank all the people who have supported the Conference and have helped and encouraged us in all the activities.

We are very grateful to our reviewers whose enormous work of assessing the papers is gratefully appreciated.

We would also like to express our appreciation to our keynote speakers for their invaluable contribution.

We would like to thank the authors themselves for contributing research papers, without whose expert input there would have been no conference.

We are thankful to our sponsor Termometal d.o.o. Ada for helping and supporting the conference.

And last but not least, we are pleased to acknowledge the assistance provided by the members of the International Scientific Committee and Technical Program Committee of the KOD 2024 Conference.

We wish You to have an interesting and stimulating conference that will bring about numerous fruitful discussions and lay the foundations for future collaboration.

Have an unforgettable stay in Balatonfüred, catch up with old friends and make some new ones.

We wish You success and progress in Your further research and great fortune and happiness in personal life.

Conference Chairs of KOD 2024

Prof. Milan Rackov, PhD. Eng.
Prof. Aleksandar Miltenović, PhD. Eng.
Prof. Milan Banić, PhD. Eng.

Balatonfüred, 23rd May 2024

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CONTENTS:

The 12th International Conference
on Machine and Industrial Design in Mechanical Engineering
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THEORETICAL RESEARCH ON TRANSIENT PROCESS IN HYDRAULIC CYLINDER WITH CONICAL CUSHIONING DEVICES

Sasko Dimitrov[1], Sara Srebrenkoska[1], Dejan Krstev[1], Mishko Dzidrov[1], Marija Cekerovska[1] and Todor Cekerovski[1]

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Key words: Hydraulic Cylinder, Cushioning, Transient Process.

High speed of hydraulic cylinders in combination with large moving masses can release large amounts of energy when the rod reaches the end position, which might destroy the hydraulic cylinder. In such cases, hydraulic cylinders with cushioning might be required which reduces the speed to the desire value. Ideal-ly, a constant reduction of the velocity is desired. The cushioning design used should accomplish this objective with effectiveness in all of the operating ranges of the cylinder at the minimum pressure.

The principal of operation of the cushioning theoretically researched in this paper has been shown on fig.1. Smooth stopping at the end of the cylinder stroke is performed by cushioning devices built into its covers [7]. Upon reaching the distance L_d before the end of the stroke, a specially shaped protrusion to the piston closes a certain space from the return area of the cylinder, forcing the oil from this chamber to pass through a throttle with section area A_{ds}. The pressure in the enclosure chamber increases to p_d, creating a braking force. The deceleration is determined by the size of the throttle section area A_{ds} during the braking distance L_d.

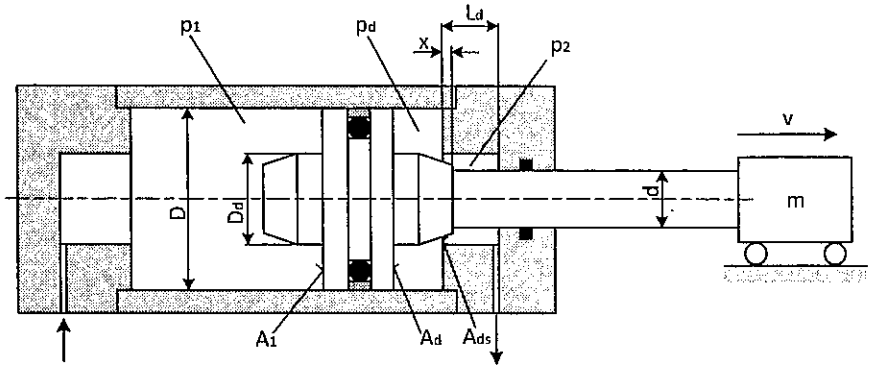

Figure 1. Cushioning device in hydraulic cylinders

The differential equation describing the movement of the hydraulic cylinder rod is

$$\frac{dV}{dt} = A \cdot \left(1 - V^2\right) - B \cdot V \cdot C(X)$$

The solution of the differential equation represents the simulation of the transient process of the moving mass. For solution of the nonlinear differential equations, the adaptive Runge-Kutta method is used. This method based on the forth order Runge-Kutta method esti-mate the truncation error at each integration step and automatically adjust the time step size to keep the error within prescribed limits.

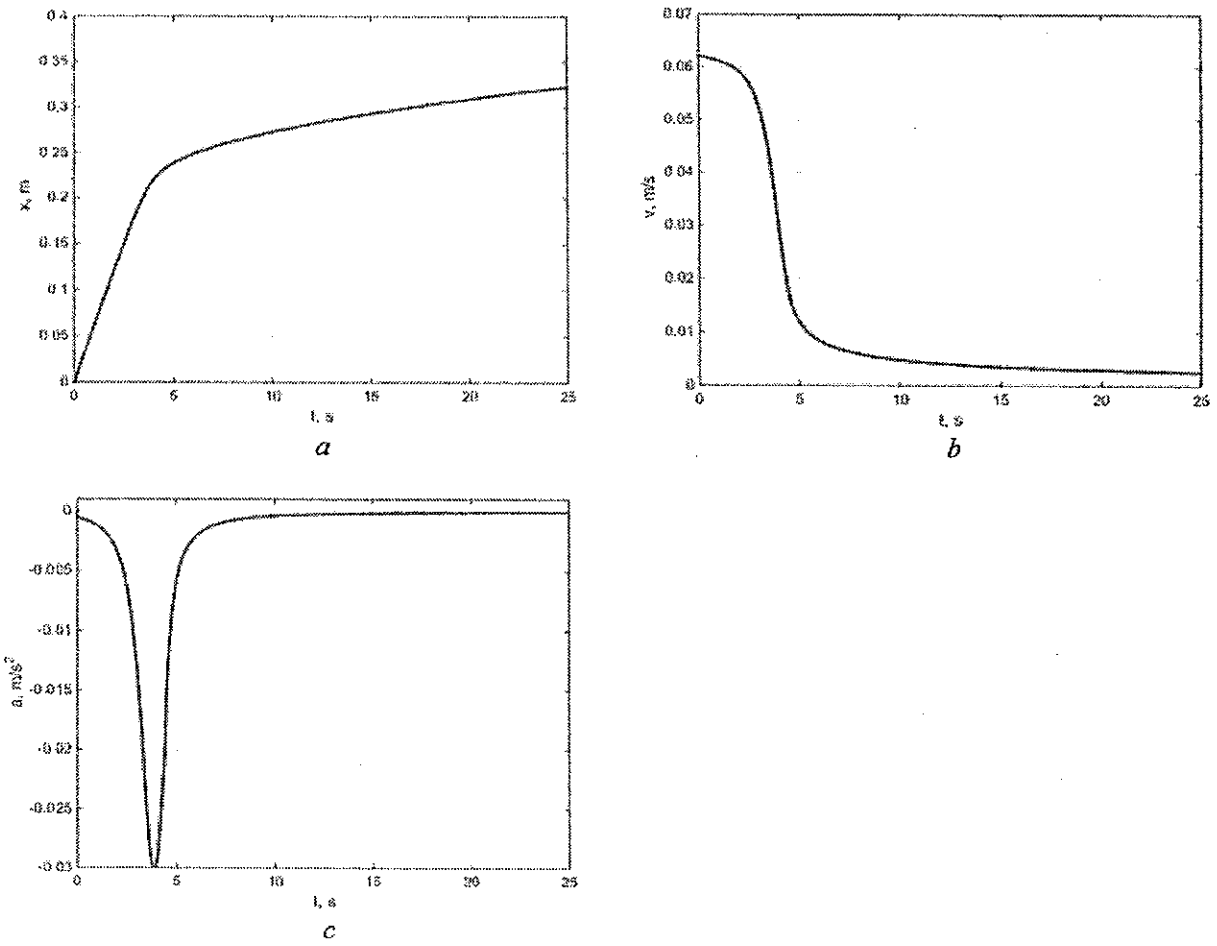

Figure 2. Transient process in terms of time

In this work a mathematical model of a conical cushioning device in hydraulic cylinders is developed and simulated the transient process at the end of its stroke. The proposed cushioning device ensures smooth deceleration at the beginning and at the end of the transient process with relatively low additional overload on the hydraulic cylinder as a result of the deceleration. This type of cushioning provides good cylinder speed profile in time without pressure peaks in the cylinder chambers.

As it was presented in the diagrams above, it is necessary cushioning devices to be included in the hydraulic cylinders when they move large masses with high speeds to absorb the high potential energy when they stop.

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