

# MODELLING AND SIMULATING A CONTROLLED PRESS-BRAKE SUPPLY SYSTEM

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## Abstract

Modern machinery and equipment manufacturers incorporate advanced technology into their products. This is especially true for those applications where an electro-hydraulic supply system is used, e.g. on tool and metal shaping/forming machines. Such machines represent a complex and multitechnological mechatronic system, and should be first modelled and simulated, especially in respect of dynamic behaviour.

This paper presents a theoretical analysis of an energy-saving and cost-effective electro-hydraulic supply system on a hydraulic press-brake, used within the automotive industry. It emphasises the designing an adequate mathematical-simulation model, to serve as the basis for decisions concerning the used supply system's dynamic.

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**Key Words:** Metal Forming Machines, Electro Hydraulic System, Modelling, Simulation

## 1. INTRODUCTION

Reductions in energy consumption and noise reduction regarding drive systems, as well as cost-effectiveness, are increasingly important factors in modern machinery design. All of the above requirements are especially important for machines equipped with hydraulic supply and drive systems. Only the principle of volumetrically-controlled hydraulic energy (variable supply systems e.g. with the use of variable pumps), has proved satisfactory for the above requirements. In this regard, electro-hydraulic solutions in particular, make it possible to use all the advantages of modern electrical signal transmission and controller designs.

Such variable supply systems can be, in principle, controlled hydraulically or electrically. Constant-speed induction motors in combination with a variable displacement volume pump are commonly used solutions, in order to control flow, or consequently, the pressure of the medium. The second concept, for the same purpose, representing the application of a constant displacement volume pump in combination with variable rotational speed motors, has recently gained significance in praxis due to its attractive price. Such systems provide several advantages such as economical use of energy, user-friendly process control, and ease of maintenance, when compared to hydraulic-mechanical solutions.

In particular, electro hydraulic variable-speed constant pumps have recently been the object of some fundamental research work (see e.g. [1-3]), and work describing early applications of novel control principles (e.g. for use in Plastic Injection Moulding Machines [4-5]). The speed-controlled pump drive concept is still an attractive subject for detailed research [6-8].

In such solutions, the implementation of electric, electronic, electrical sensor and modern actuator technologies is very important for the evolution of intelligent electro-hydraulic systems. Such systems provide several advantages such as economical use of energy, user-friendly process control and ease of maintenance, compared to the hydraulic-mechanical solutions. However, from the designer's point of view they are more demanding.

## **6. CONCLUSION**

The presented work dealt with the modelling and simulation of a modern controlled-hydraulic supply system, where the control of flow or pressure (also control of power) is achieved using a constant pump, in combination with a speed-controlled induction motor. The suggested drive concept was applied in a press-brake.

The discussed system represents an example of a multitechnological mechatronic system, where different technologies met together: electrical, electronic, sensor technology, control technology in combination with hydraulic drive technology with all its specific characteristics. The modelling of such systems leads to a very complex mathematical and simulation model, which must be suitable for engineering use, to assume the use of available software and, of course, provide enough details about what occurs in any part of the system and with the system as a whole.

The results, obtained from a computational model of the entire system showed that the suggested selection of drive components was appropriate for a new drive-design. The experimental results confirmed the findings obtained by the developed mathematical model. So the presented theoretical and experimental study can serve as a fundamental analysis for the implementation of supply systems with speed-controlled induction motors, in the field of metal forming and similar machines equipped with hydraulic supply system.

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