EAN 2017
55th conference on experimental stress analysis

Experimental analysis of shearing power during chain production

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Keywords: Roller chain; Measurement, Punching tools

Introduction

This paper is focused on measuring of shearing power during chain production. One of the most important factors for chain quality is accuracy of manufacturing. Default accuracy of manufacturing is given by standards (e.g. DIN 8187, ČSN 02 3311) [2]. Experimental analysis is dealing with roller chains for motorcycle chain gears. These chains are very dynamically stressed. Therefore that is very important for accuracy of manufacturing. Production cutting tools are made with prescribe accuracy and that is subject to subsequent review. Next influence is action force on cutting tools during the shearing. Shearing power deforms cutting tools, this leads to an increasing of the accuracy of manufacturing. For this purpose it decides to determine the deformation of these components (shearing power). Shearing power and deformation are analyzed on cutting tools for roller chains.

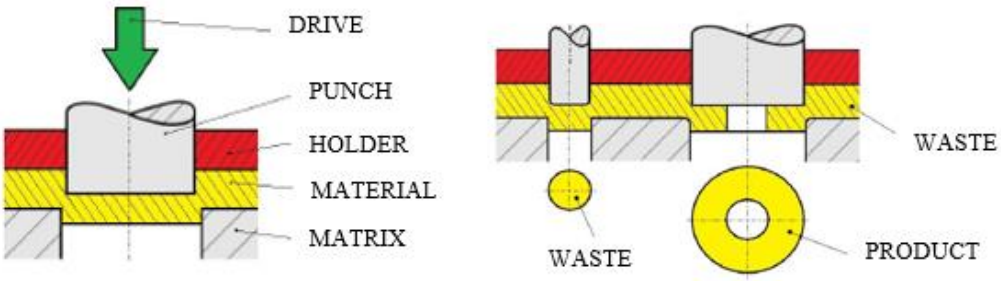

Fig. 1 Cutting tools and roller chain production [2]

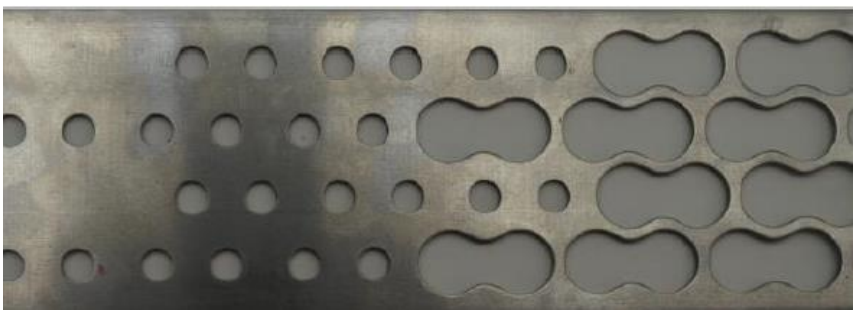

Fig. 2 The steel plate passed through the tool [2]

Measurement

The measurement was made by strain gauges on cutting tools (Fig. 3). Tensile/compressive stress and bending stress were measured for deformation analysis on punches and four strain gauges were installed on each of the punch (Fig. 4). Each strain gauge was connected separately to the quarter bridge.

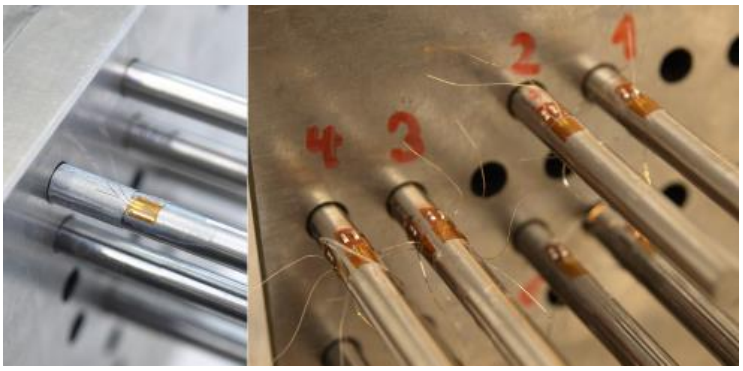

Fig. 3 Punches with strain gauges [2]

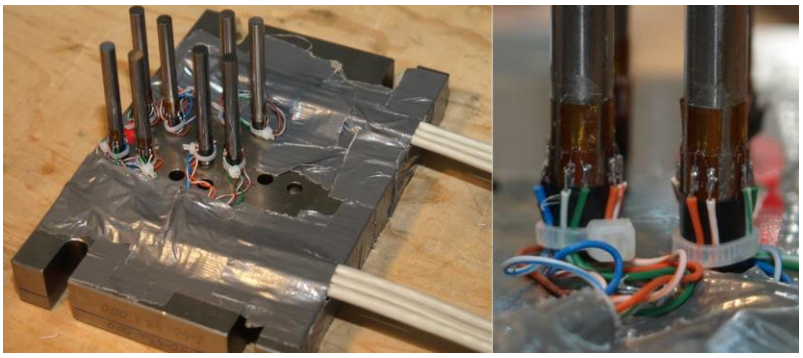

Fig. 4 Connected strain gauges on punches [2]

Tension is measured by all four strain gauges SG1, SG2, SG3 and SG4 (Eq. 1). Following punches loading are bend. That is determined in two planes. The first plane is given by strain gauges SG1 and SG3, the other plane is given by strain gauges SG2 and SG4. Therefore bending stress is calculated in this two planes by Eq. 2 and Eq. 3. [1]

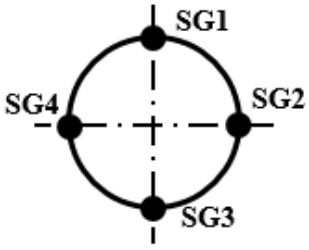

Fig. 5 Arrangement of the strain gauges on punches

$$\sigma_t = \frac{E \cdot (\varepsilon_1 + \varepsilon_2 + \varepsilon_3 + \varepsilon_4)}{4} \qquad (1)$$

$$\sigma_{b1} = \frac{E \cdot (\varepsilon_1 - \varepsilon_3)}{2} \quad (2)$$

$$\sigma_{b2} = \frac{E \cdot (\varepsilon_2 - \varepsilon_4)}{2} \quad (3)$$

Results

The tensile force is given by Eq.4 and the resultant bend by Eq. 6.

$$F_t = \sigma_t \cdot A = \frac{E \cdot (\varepsilon_1 + \varepsilon_2 + \varepsilon_3 + \varepsilon_4)}{4} \cdot A \quad (4)$$

$$M_b = \sqrt{M_{b1}^2 + M_{b2}^2} = \sqrt{(\sigma_{b1} \cdot W_o)^2 + (\sigma_{b2} \cdot W_o)^2} \quad (5)$$

$$M_b = \sqrt{\left(\frac{E \cdot (\varepsilon_1 - \varepsilon_3)}{2} \cdot W_o\right)^2 + \left(\frac{E \cdot (\varepsilon_2 - \varepsilon_4)}{2} \cdot W_o\right)^2} \quad (6)$$

Time behavior of the punches tensile force and punches bend are presented on Fig.6 a Fig.7. Cycle punches of operation were divided into the several parts for the tensile force measurement – getting into the contact with material, penetrating through material, getting out of material, broaching in the final hole, finishing in bottom dead center and pulling out.

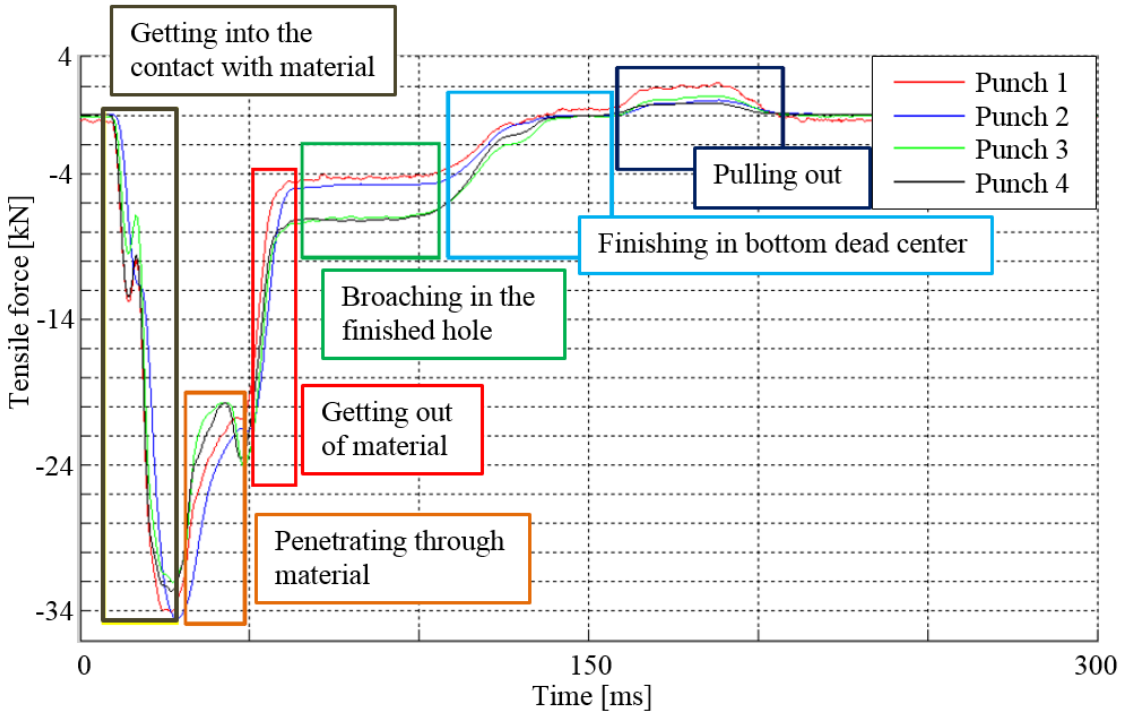

Fig. 6 Time behavior of the punches tensile force

Bend measurement cycle of operation was divided into three parts - penetrating through material, getting out of material and broaching in the final hole.

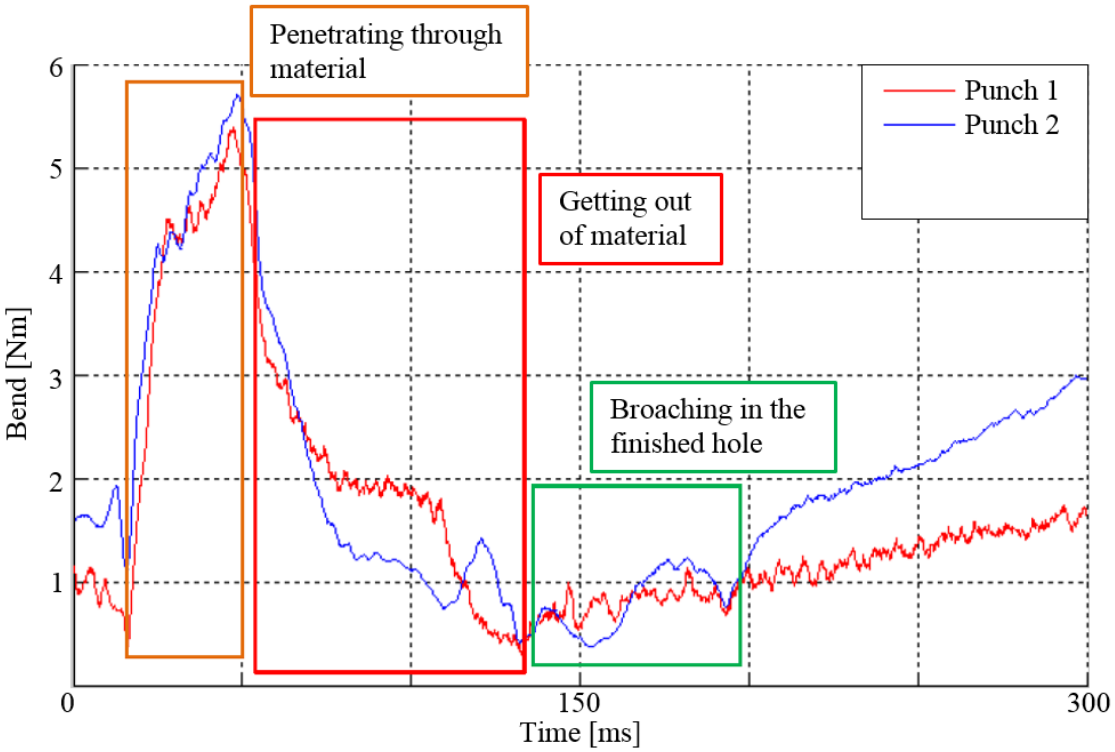

Fig. 7 Time behaviour of the punches bend

Conclusions

These analysis enables to determine shearing power during roller chain production, when tension/pressure and bend are measured (Fig. 8). Parasitic bend has a negative impact on accuracy manufactured roller chain. Bend was found based on the measurement and bend is caused accuracy of manufacturing, therefor adjustment was designed for the punching tools.

Fig. 8 Measurement on the punching tools

References

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