

Strain Gauge Measurement on the Oilseed Screw Press

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Abstract. This paper gives the description of the preparation, implementation and execution of the experimental measurement on the oilseed screw press. Set of nine strain gauges placed on the basket ribs of the machine were used to obtain the distribution of the pressure along the basket during the operation. Moreover, special pressure gauge was used to obtain the absolute value of the pressure in the chosen places of the basket.

Introduction

Measurements and experimental testing on machines during real conditions become important in these days. The results from experiments are primarily used for analysis of real operational parameters that can be further used for the subsequent optimization of the specific parts or structural units. The measurements are also used for validation of different computational simulations and analysis so they can be compared with the reality, [1], [2].

Various data can be measured on this specific oilseed screw press. In addition to the described measurement on the basket ribs with help of strain gauges and measurement of the pressure using special gauge, temperature of the processing material in the machine or forces on the shaft were also measured.

Method

The strain gauge measurement on the basket ribs of the oilseed screw press was carried out to obtain the relative values used for definition of the pressure distribution along the basket of the machine. The absolute value of the pressure in the basket is not possible to obtain using strain gauge in this method, however special calibrated pressure sensor can be used. Another possibility for pressure measurement in the basket is to use special measuring element, [3].

Investigated machine. The measurement described in this text was carried out on the oilseed screw press (figure 1) in the premises of the machine producer during the operation of pressing the oil [4]. So the main aim of the experiment was to obtain the parameters of the real working process.



Fig. 1: Oilseed screw press FS 1010, [4]

Instrumentation and measurement protocol. The scheme of the machine is shown in figure 2, where the shaft with screws and inserts, or the position and numbering of strain gauges on the ribs of the basket can be seen. The material input to the oil press is in radial direction to the axis of the shaft in the place of rib number 17, the processed material flows in the direction of the decreasing strain gauges numbers to the axial output at the end of the shaft. During the flow of the processed material through the working chamber the oil is extracted.

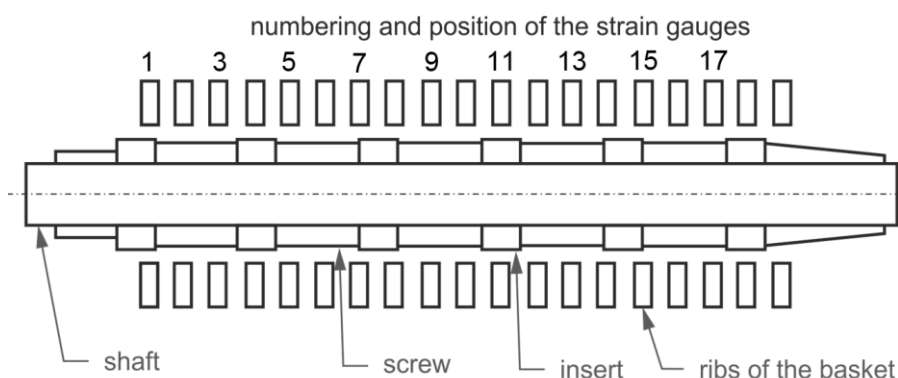


Fig. 2: Scheme of the ribs and shaft of the tested machine

The set of nine T rosette strain with two measured grids gauges (1-XY91, [5]) on the ribs of the basket were used. The configuration of the strain gauges was half-bridge type for temperature compensation, the position of strain gauge resistors is in figure 3

The special calibrated miniature pressure transducer Burster Model 81530 connected as full-bridge was used to measure absolute value of the pressure along the basket of the press in the specified places [6].



Fig. 3: Strain gauge on the rib of the basket

The operational conditions in the machine are unfavourable (high temperature, dirt, abrasion, oil etc.) so special procedures for the measurement preparation had to be used (special glue, strain gauge protection, cabling, temperature compensation).

The special two components epoxy adhesive X280 from HBM was used for the installation of strain gauges, [5], because this adhesive offers high temperature resistance (up to 200°C). The curing time is eight hours at room temperature with applied pressure of 10 to 50 N/cm², therefore special fixture was used during the adhesive curing (see figure 4).



Fig. 4: Applying of the pressure during the adhesive curing

The protected set of the strain gauges on the ribs with wiring are shown in figure 5. Special tough putty AK22 from HBM was used to protect the strain gauges and PTFE wiring with the operating temperature up to 200°C had to be used.



Fig. 5: Final measured ribs of the basket with protected strain gauges and wiring

Data acquisition and processing. The process of pressing was controlled by the PLC system with possibility of measurement and archiving of some operational parameters (motor load and revolutions, seed mass flow etc.). The National Instruments apparatus and software (PXI, LabView) were used for the strain gauge measurement with the sampling frequency of 1000 Hz. The data processing was performed in LabView software. The example of obtained data from strain gauges in graphical form for a long term measurement is shown in figure 6.

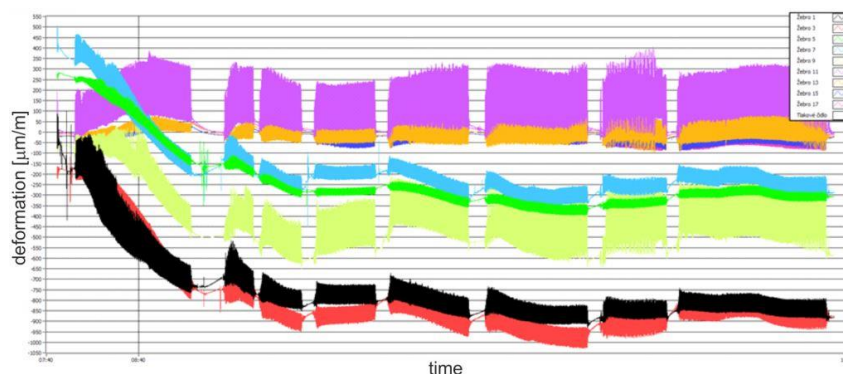


Fig. 6: Measured and processed data

Experiment outcomes. The required outcome from the measurement is the pressure distribution along the oil press basket for different operating states and processed material. The pressure of the processed material in the machine is supposed to be increased on the each insert, whereas the function of screws is to transport the material so the pressure is lower there.

Results and conclusions

The described experimental method can be used to obtain the real operational parameters of the oilseed screw press. The processed results correspond to the expectation so the measured data provide information for the design of the machine for specific oilseed and optimization of the pressing process. The obtained pressure distribution along the basket can be used as a boundary condition for the process simulations.

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