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# ***Vane tester for characterization of granular biomass***

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## OUTLINE

- 1. BACKGROUND AND PROBLEM**
- 2. VANE TESTER**
- 3. EXPERIMENTS**
- 4. RESULTS**
- 5. CONCLUSIONS**



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## BACKGROUND





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## BACKGROUND



**Woodchips 70%**  
**Snow, water !!!!**



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## BACKGROUND

- *Agro and Forest biomass*
- *Development in research and use of biomass as an alternative energy source*
- *The need for development of new technologies for harvesting, storage and processing of biomass*
- *Material characteristics for design and process control*



**BIOMASS – granular material**



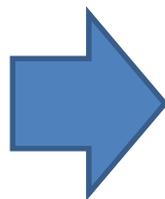
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## BACKGROUND



## TERMALL Sp. z o.o. INSTITUTE of AGROPHYSICS, POLISH ACADEMY of SCIENCES

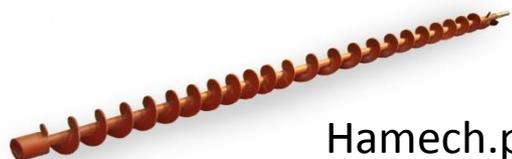


Designer and Users needs:  
Rapid determination of

- Moisture content
- Density
- Storage problems
- Problems with emptying

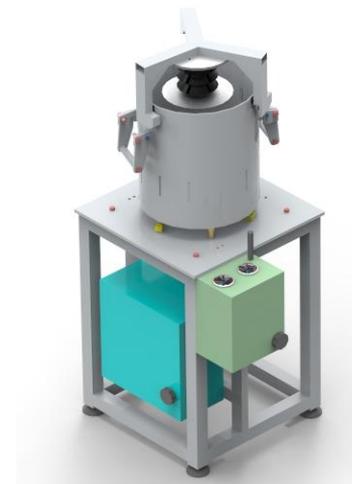
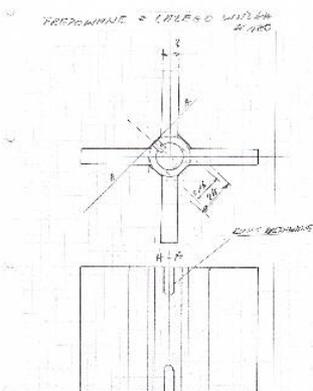
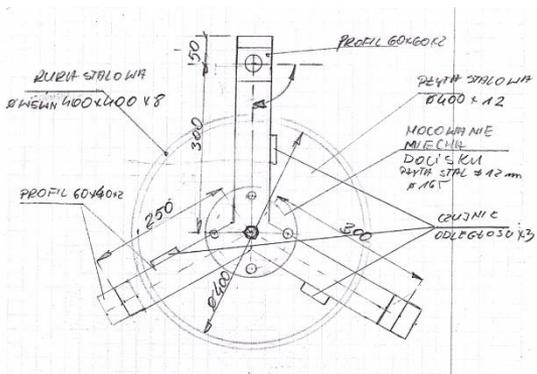
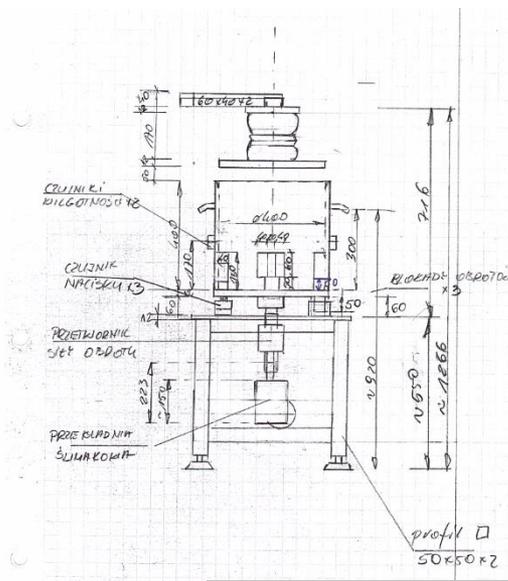
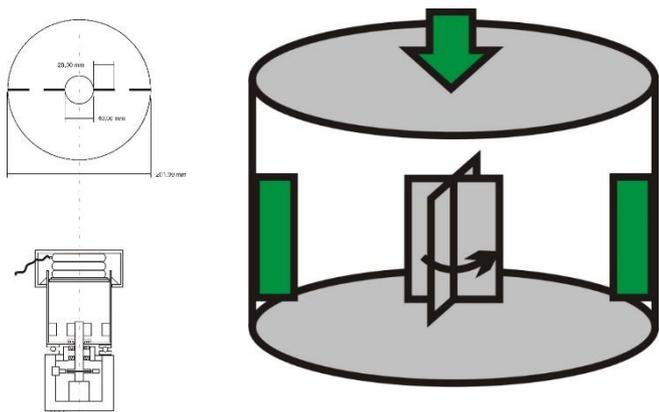


**Biomass Valuation**



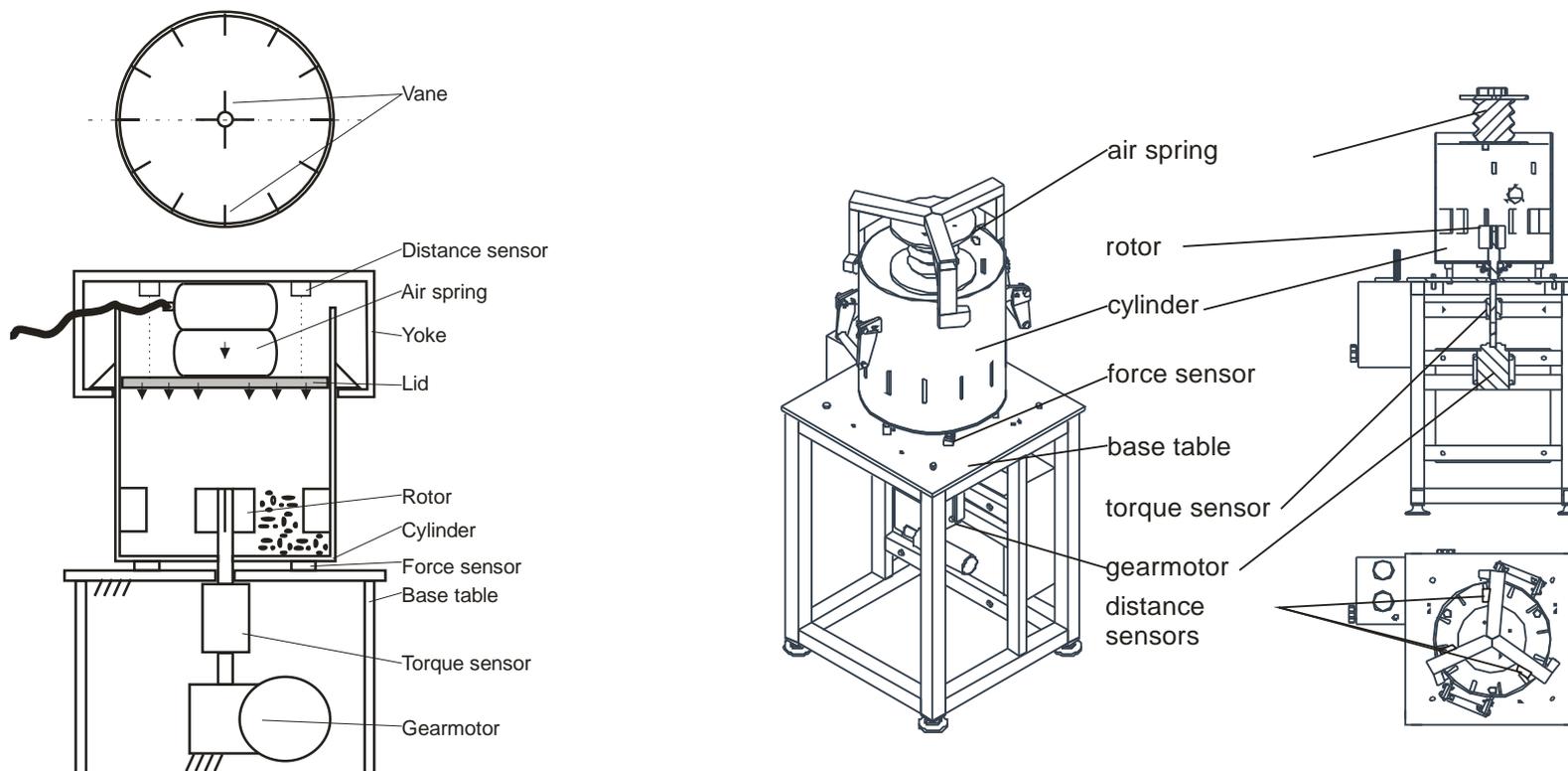
Hamech.pl

# VANE TESTER





## MEASURING DEVICE



## EXPERIMENTS

The objective of the project was an examination of samples of granular biomass, consolidated under pressure corresponding to that existing in storage silos used in power and heat plants.

Materials widely used for firing and co-firing in power and heat plants in Poland: ground rapeseed straw, pine pellet, oak sawdust, oak shavings and forest woodchips.



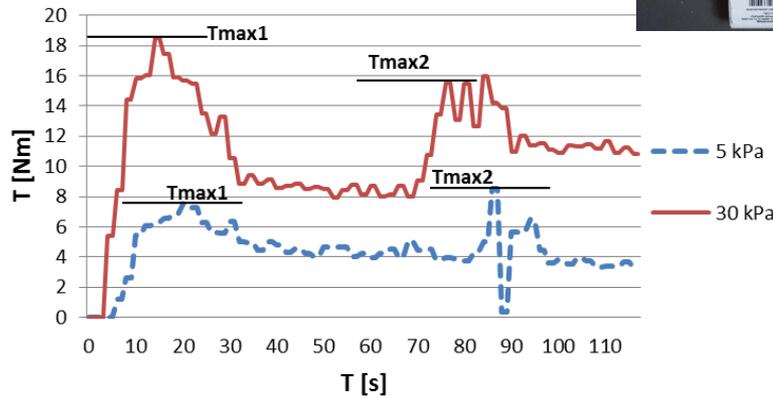
Tests were conducted under 4 levels of consolidation pressure  
5, 10, 20 and 30 kPa,  
for 4 rotation rates 3, 6, 9 and 13 rpm.

## RESULTS

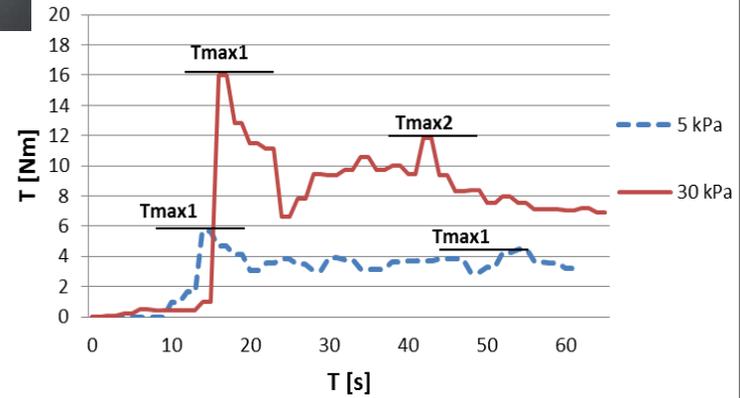
### Forest woodchips experiment



3 rpm

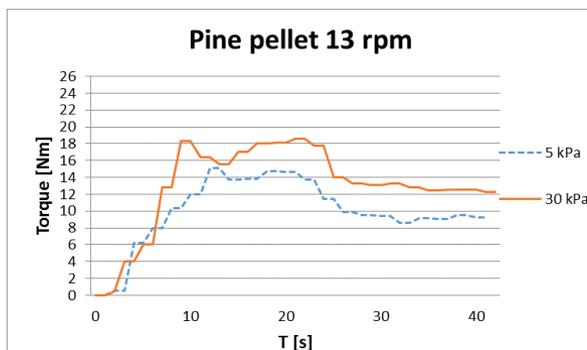
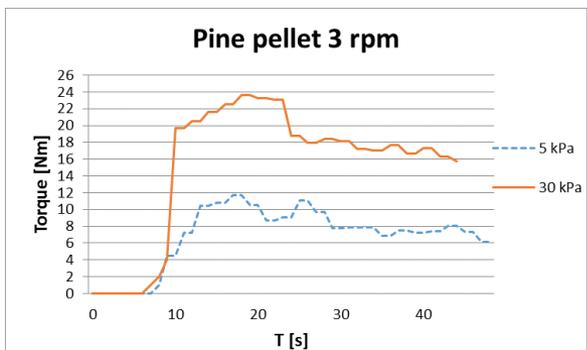
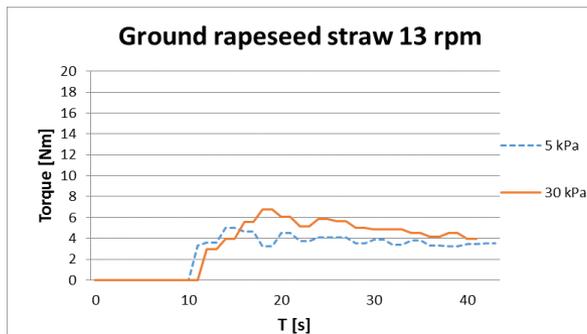
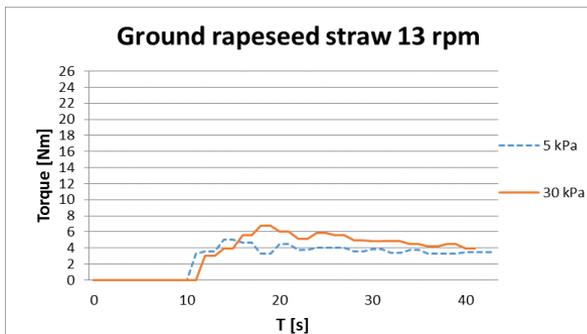


13 rpm



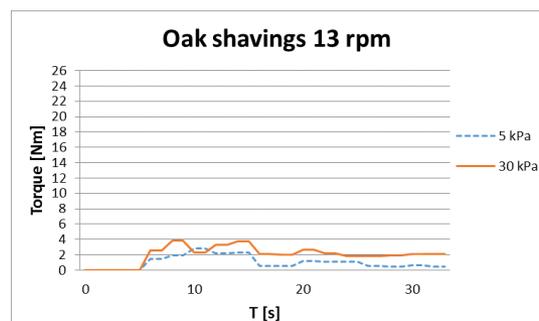
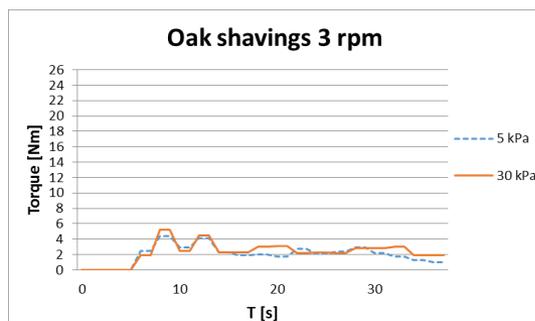
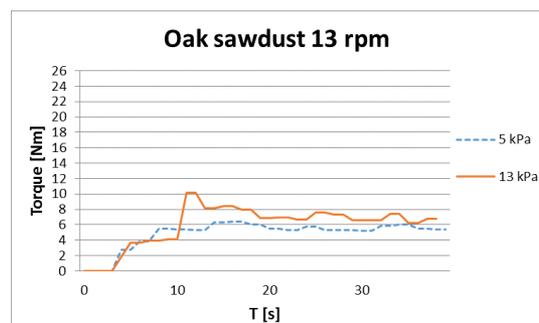
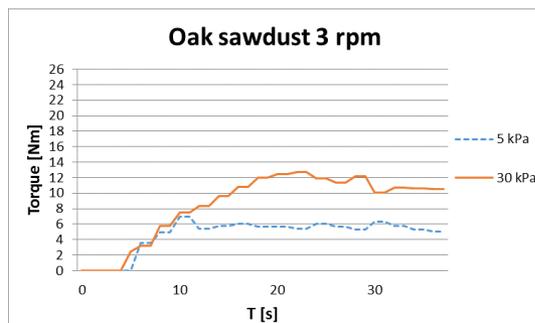
Experimental relationships of torque vs. time obtained for max. and min. consolidation pressures, for two rotation rates.

## RESULTS



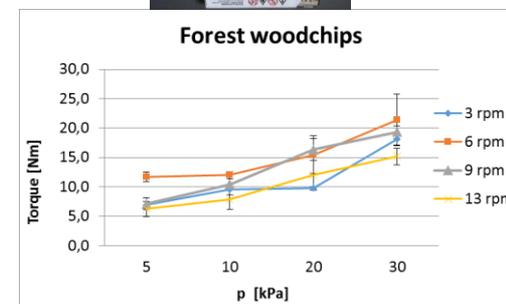
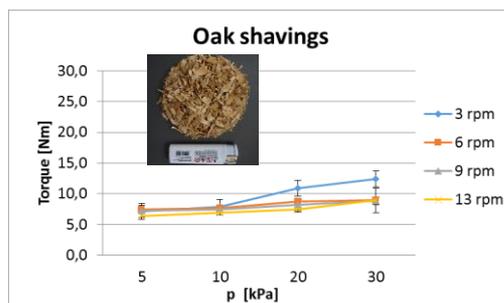
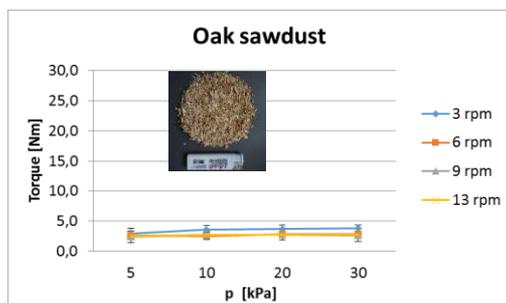
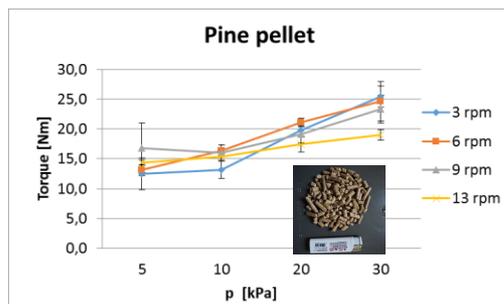
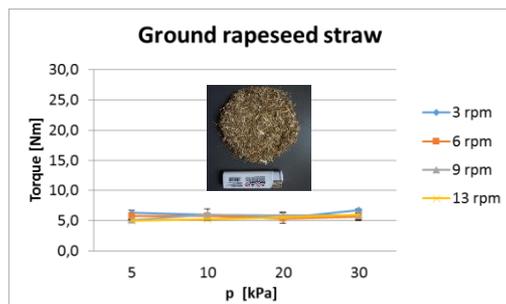
Experimental relationships of torque vs. time obtained for max. and min. consolidation pressures, for two rotation rates.

## RESULTS



Experimental relationships of torque vs. time obtained for max. and min. consolidation pressures, for two rotation rates.

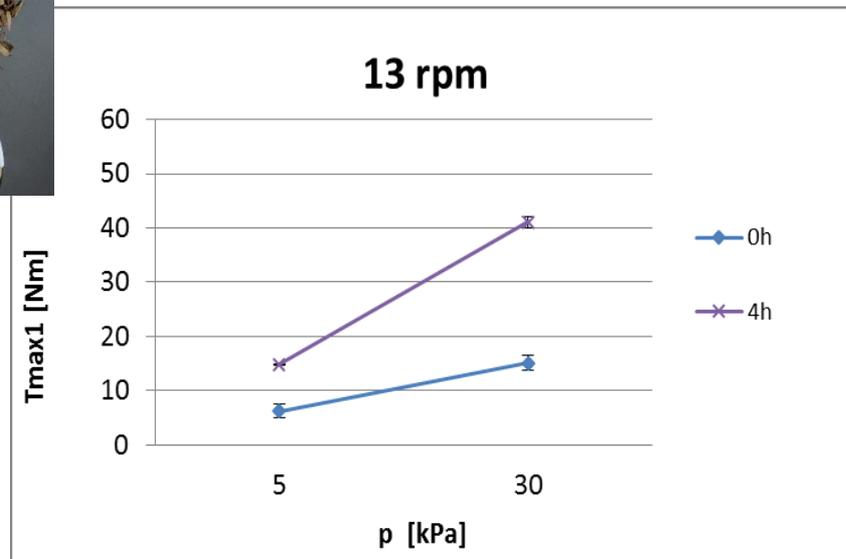
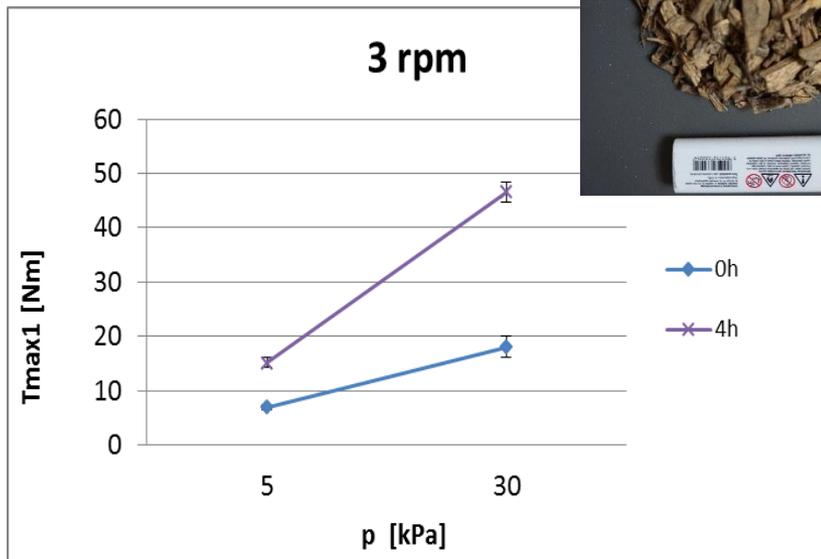
## RESULTS



Torque characteristics vs. consolidation pressure and rotation speed.

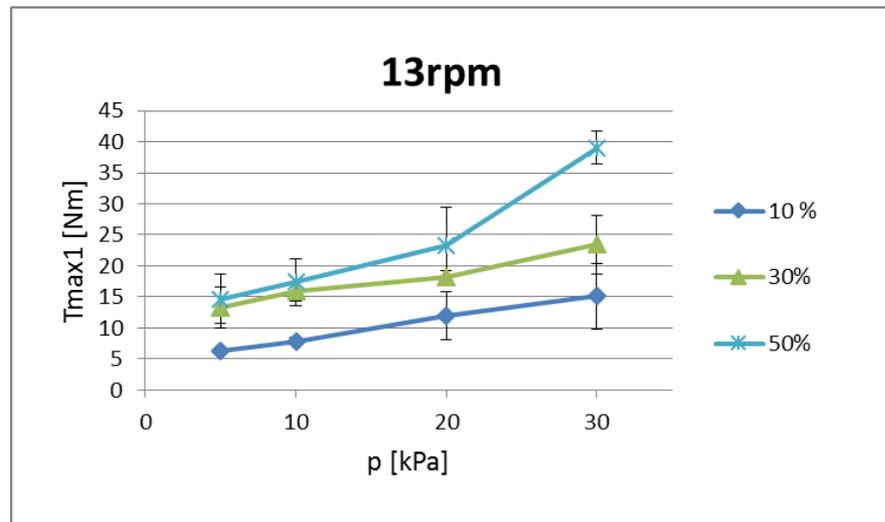
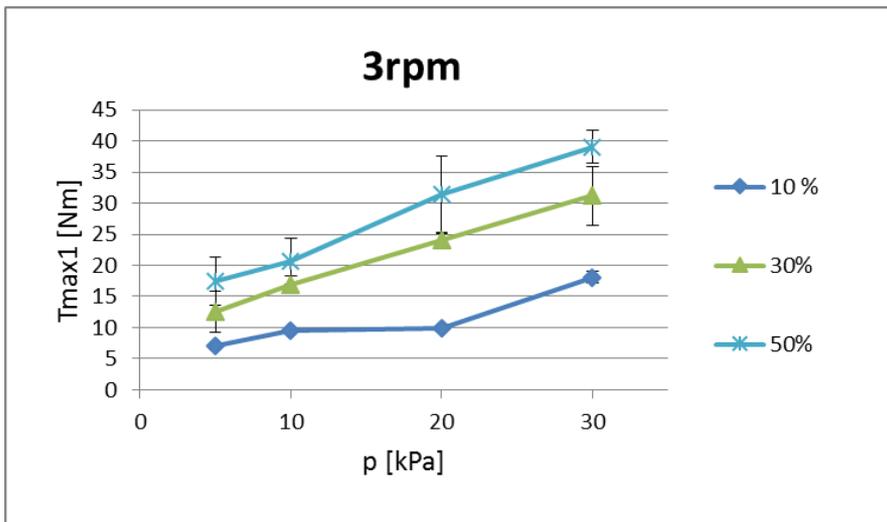
## RESULTS

### Forest woodchips



Maximal value of torque in dependence on pressure, obtained for consolidation time of 0 h and 4 h, for rotational speed of 3 rpm and 13 rpm.

## RESULTS



The evolution of the maximal torque with compression pressure for material with different moisture contents, at rotational speed of 3 rpm and 13 rpm.

*Forest woodchips*





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## CONCLUSIONS

The constructed device was found to be efficient in determination of shear characteristics of consolidated samples of granular biomass.

A strong increase in torque with an increase in consolidation pressure was observed.

No significant influence of rotation rate on the maximal torque was obtained.

The maximal values of torque, determined for consolidated material were higher than the ones obtained for unconsolidated material.

An increase in moisture content resulted in increase in  $T_{max}$  value.

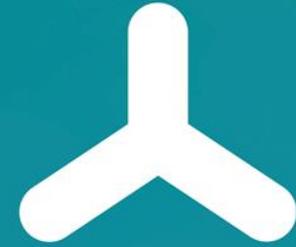


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## RESULTS





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***THANK YOU!***