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# **Modification Effect of the Core Layer with Addition of Shives for Particleboard Manufacture**

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# SUMMARY

- **wood-based industry**
- investigation of **hemp shives utilization**
- partial **substitution of wood**
- possible application of hemp shives in the **particleboard manufacture**
- experiment focused on proposal of the modification of the **particleboard core layer**
- investigation on **ratio of hemp shives** in wood particleboard core layer
- **aim**: high quality particleboard with high quality properties

- worldwide **shortage of wood** intended for wood processing industry
- reason for searching of the opportunities to incorporate a certain proportion of **hemp shives** to the **core layer of particleboard**



## Reason for the research

- disadvantage of wood raw material is the **constant price increases**
- **sufficient available quantity** of hemp shives
- its **reasonable price**
- price could be **at least slightly lower** than the wood raw material price
- in the **core layer** of particleboard
- an important issue is the **preservation** of the **physical and mechanical properties** of particleboard with the addition of hemp shives in the core layer in comparison with all-wood particleboard

# Wood Particles and/or Hemp Shives



Wood Particles



Hemp Shives

# Chemical Composition

|                          | Wood Particles | Hemp Shives |
|--------------------------|----------------|-------------|
| Cellulose                | 50 %           | 44 – 55 %   |
| Hemicelluloses           | 8 – 10 %       | 16 - 18 %   |
| Lignin                   | 28 – 30 %      | 4 – 28 %    |
| Extractive<br>Substances |                | 4 - 18 %    |
| Other<br>Substances      |                | 6 – 7 %     |

# Utilization of Hemp Shives in Wood Processing Industry

- pioneer years 1930 – 1950
- good times 1950 – 1985
- administration problems 1985 – 2005
- **new challenge 2005 - ???**
- **100 % hemp shives boards:**
  - acceptable properties
  - dimensional stability
  - various thicknesses
  - appropriate density
  - insulating boards
  - medium/hardboards
  - surface treatments



# Materials and Methods of Investigation

- **Aim: same technical and technological parameters** as used in routine practice for the particleboard production
- dimensions of the laboratory prepared boards:
- width: 300 mm, length: 400 mm
- thicknesses: 16 mm and 18 mm
- density: 600-630 kg.m<sup>-3</sup>
- moisture content around 5 % after conditioning
- **10 %** of adhesive coating to particles in **surface layers** and **6 %** of the adhesive coating to particles in **core layer**
- paraffin emulsion
- pressing temperature was 220 °C
- compression factor of 8 s.mm<sup>-1</sup>

# Materials and Methods of Investigation

- ratios of hemp shives and wood particles for the core layer:
- 0 % of hemp shives – 100 % of wood particles
- 5 % of hemp shives – 95 % of wood particles
- **10** % of hemp shives – 90 % of wood particles
- **11** % of hemp shives – 89 % of wood particles
- **12** % of hemp shives – 88 % of wood particles
- **13** % of hemp shives – 87 % of wood particles
- **14** % of hemp shives – 86 % of wood particles
- **15** % of hemp shives – 85 % of wood particles
- **16** % of hemp shives – 84 % of wood particles
- **17** % of hemp shives – 83 % of wood particles
- **18** % of hemp shives – 82 % of wood particles
- **19** % of hemp shives – 81 % of wood particles
- **20** % of hemp shives – 80 % of wood particles
- 25 % of hemp shives – 75 % of wood particles
- 30 % of hemp shives – 70 % of wood particles

# Laboratory Production of Particleboard

- same technical and technological parameters as used in routine practice for particleboard production

**Preparation of Materials:** particles and hemp shives



# Adhesive Coating



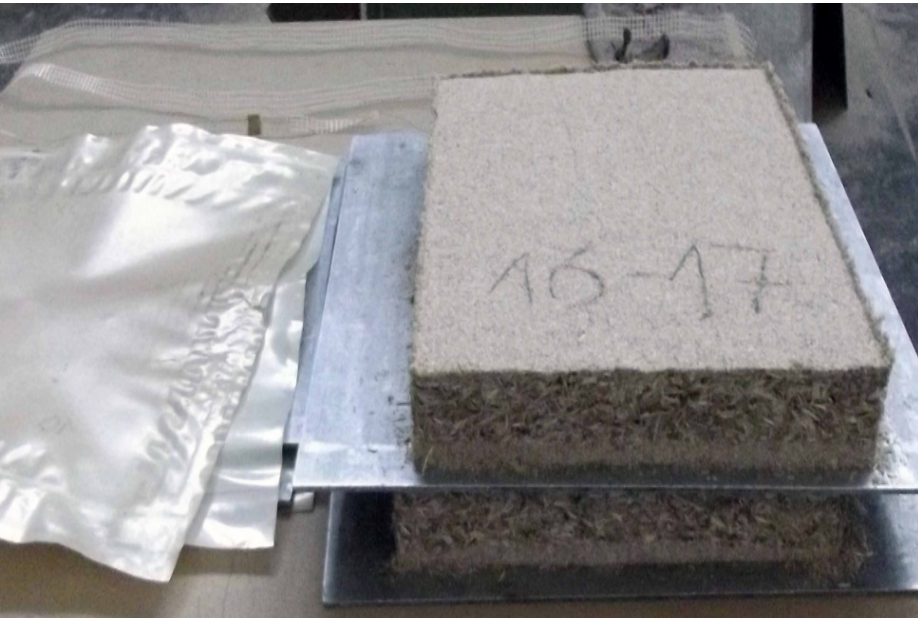
# Matt Forming



# Pre - Pressing



# Matts of Boards Prepared for Pressing



# Matts of Boards Prepared for Pressing



# Equipment for Temperature Measuring



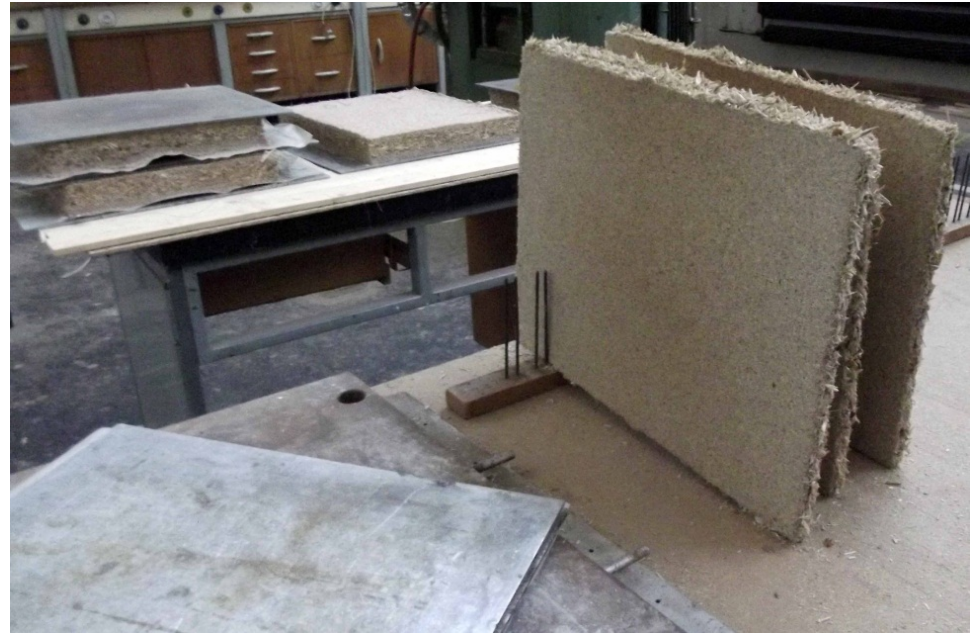
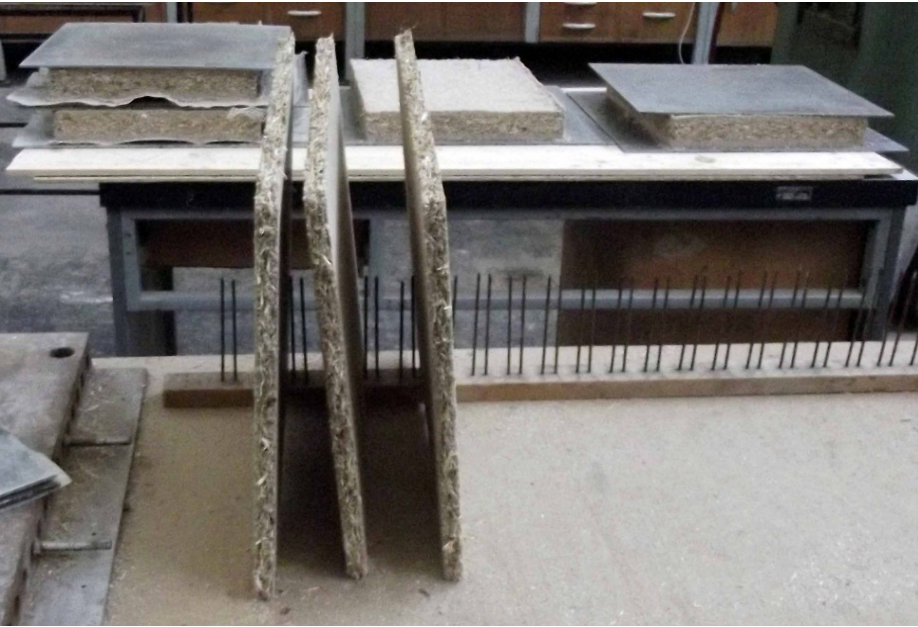
# Pressing



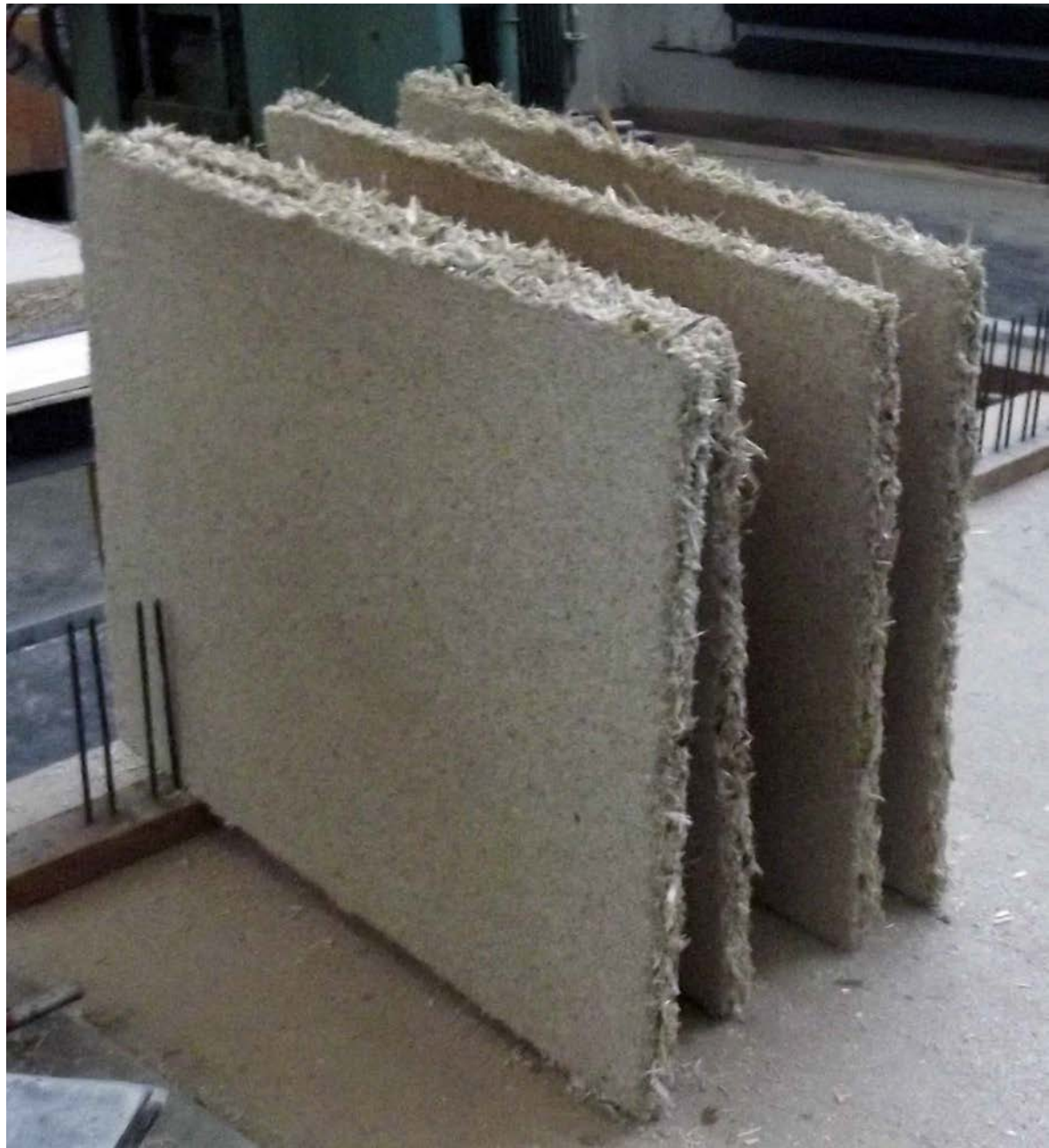
# Pressing



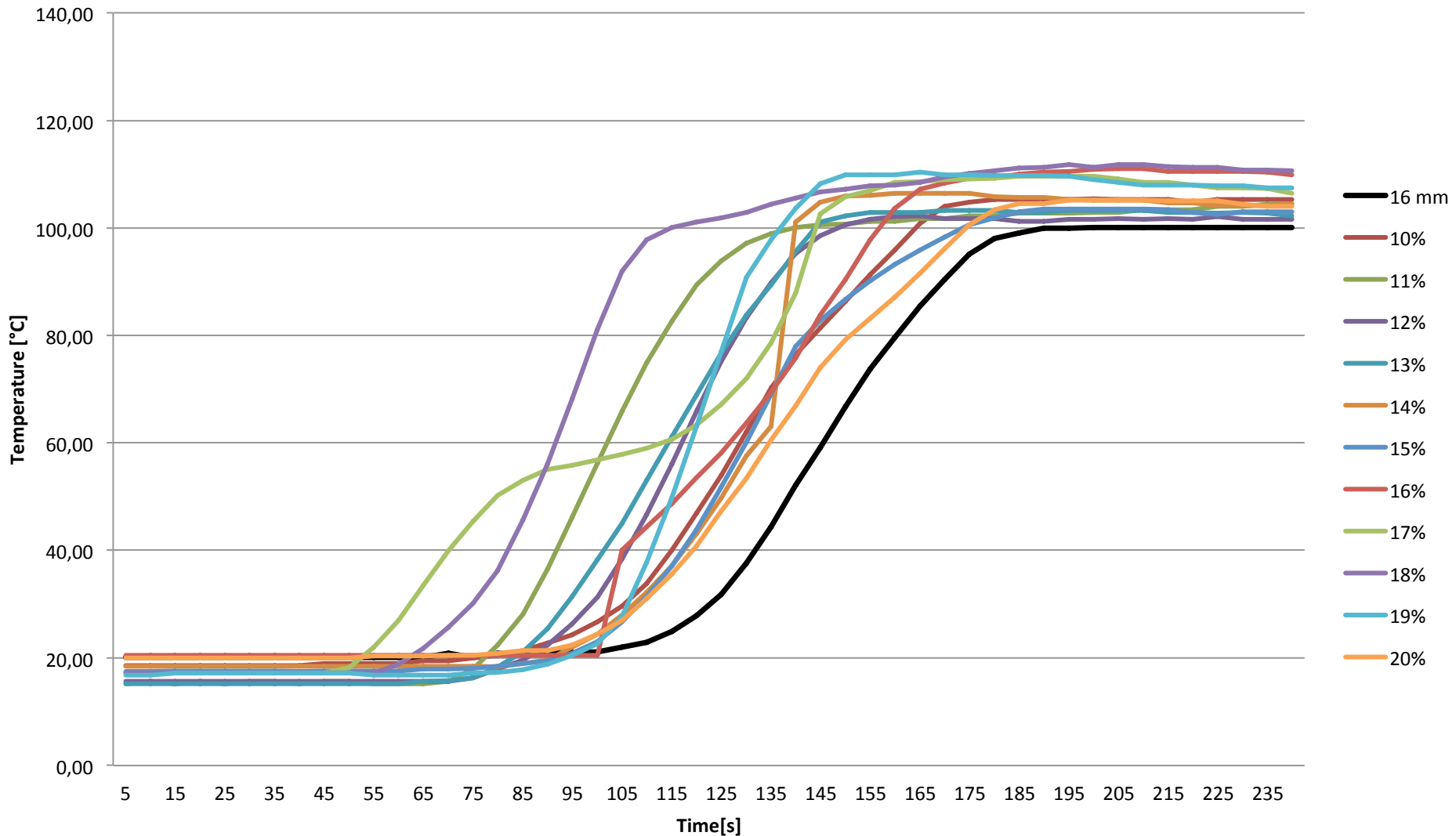
# Wood/Hemp Shives Boards



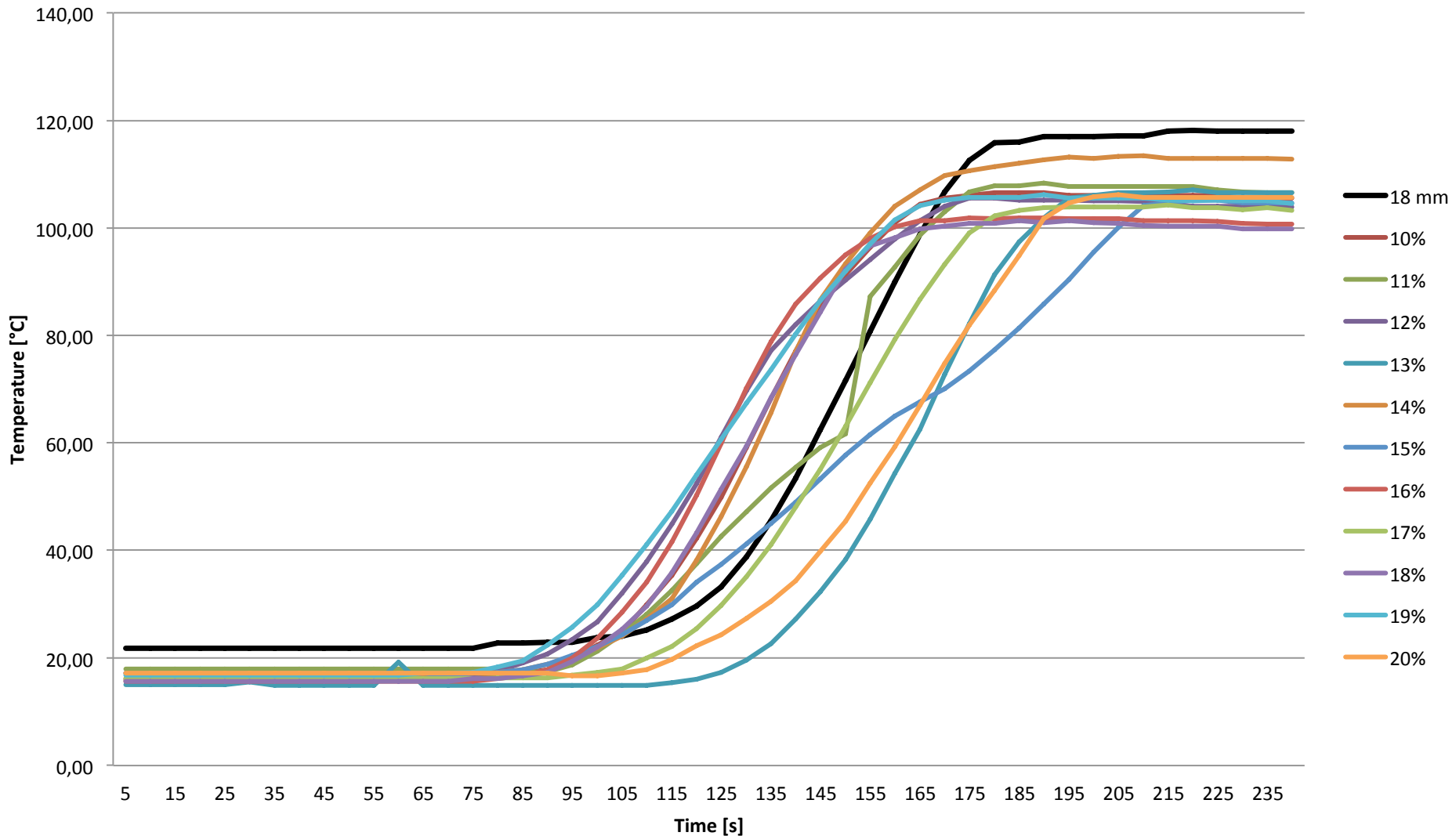
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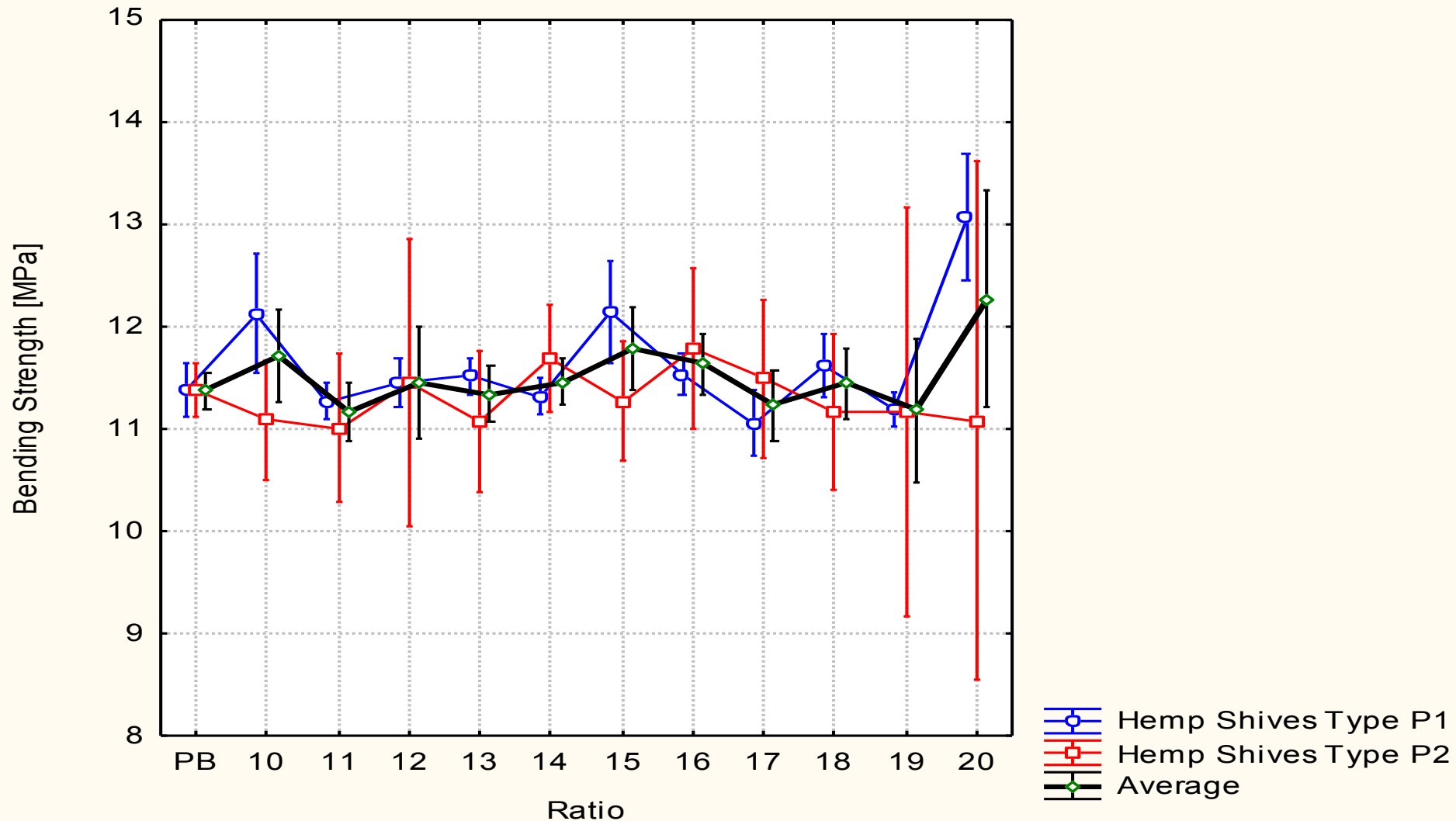
## Pressing Temperature



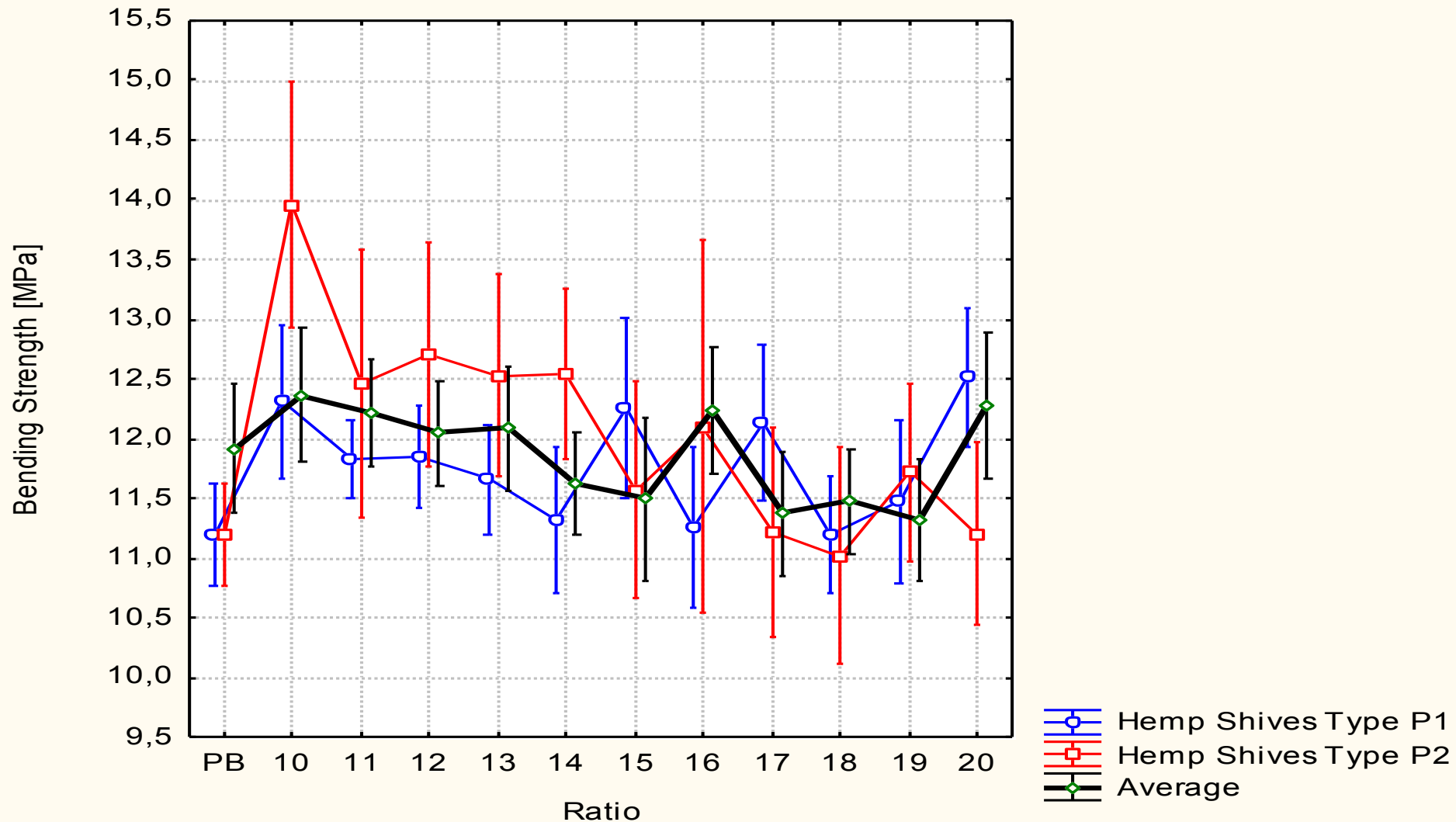
## Pressing Temperature



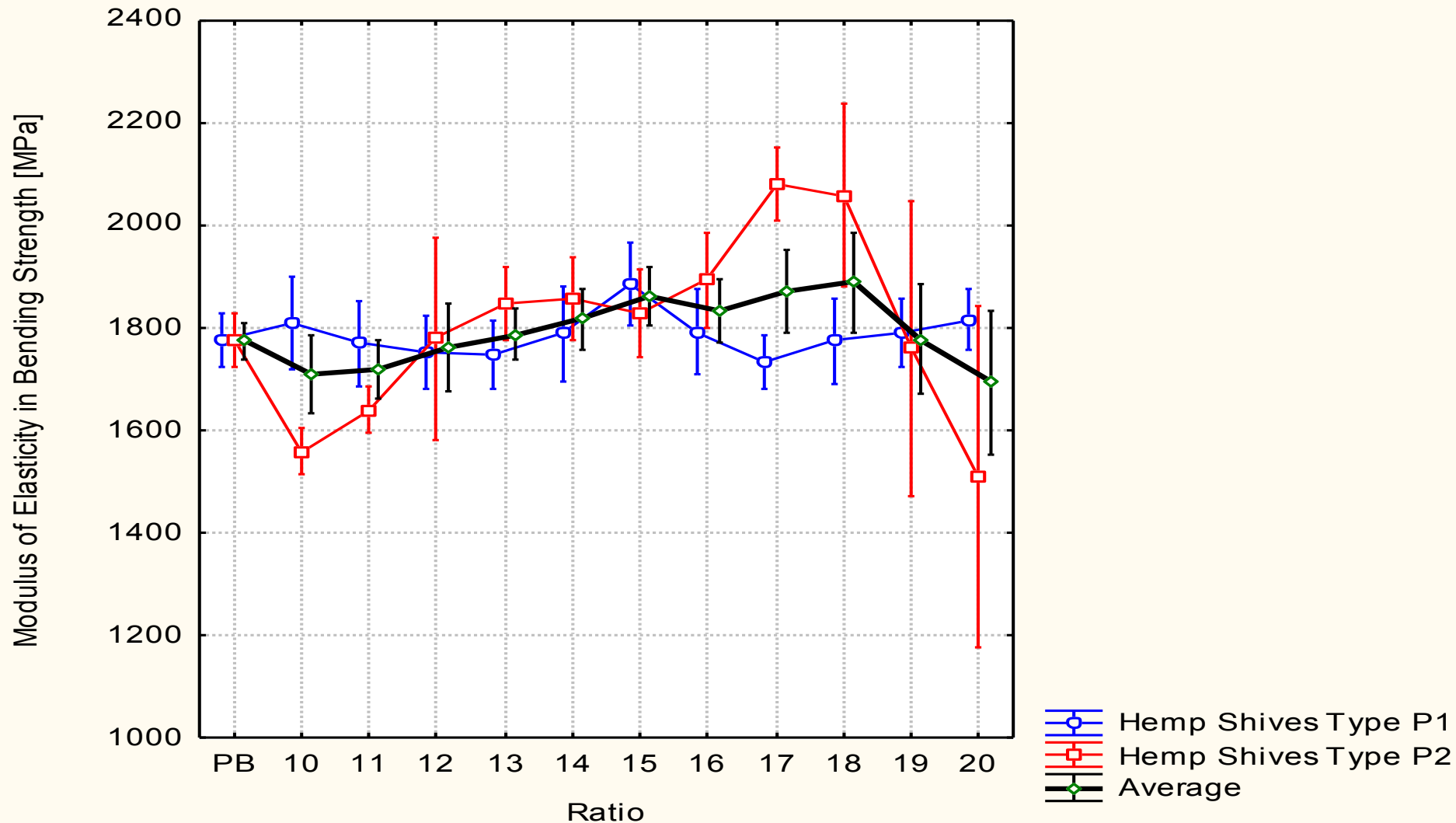
# Bending Strength of 16 mm Particleboard



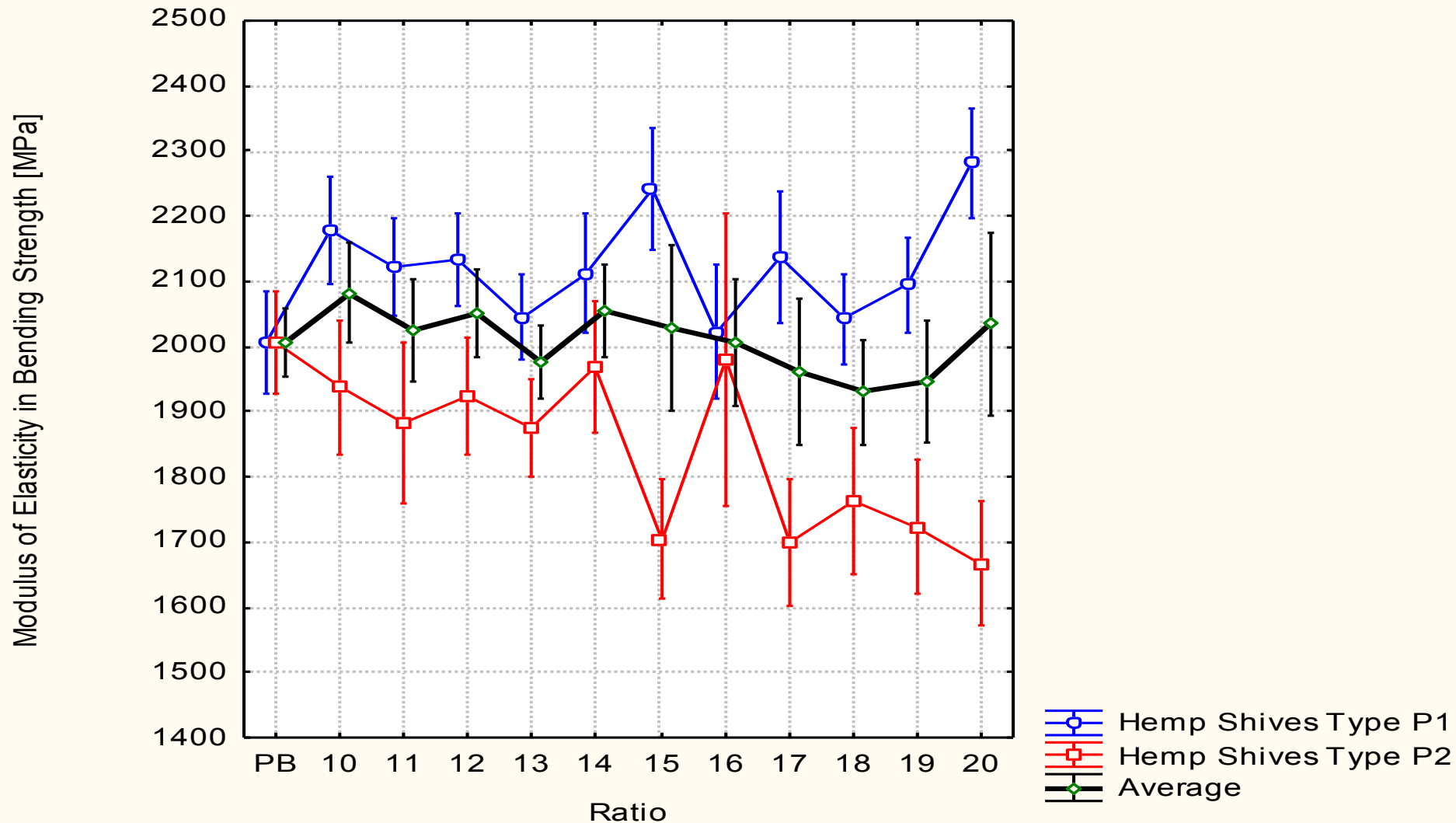
# Bending Strength of 18 mm Particleboard



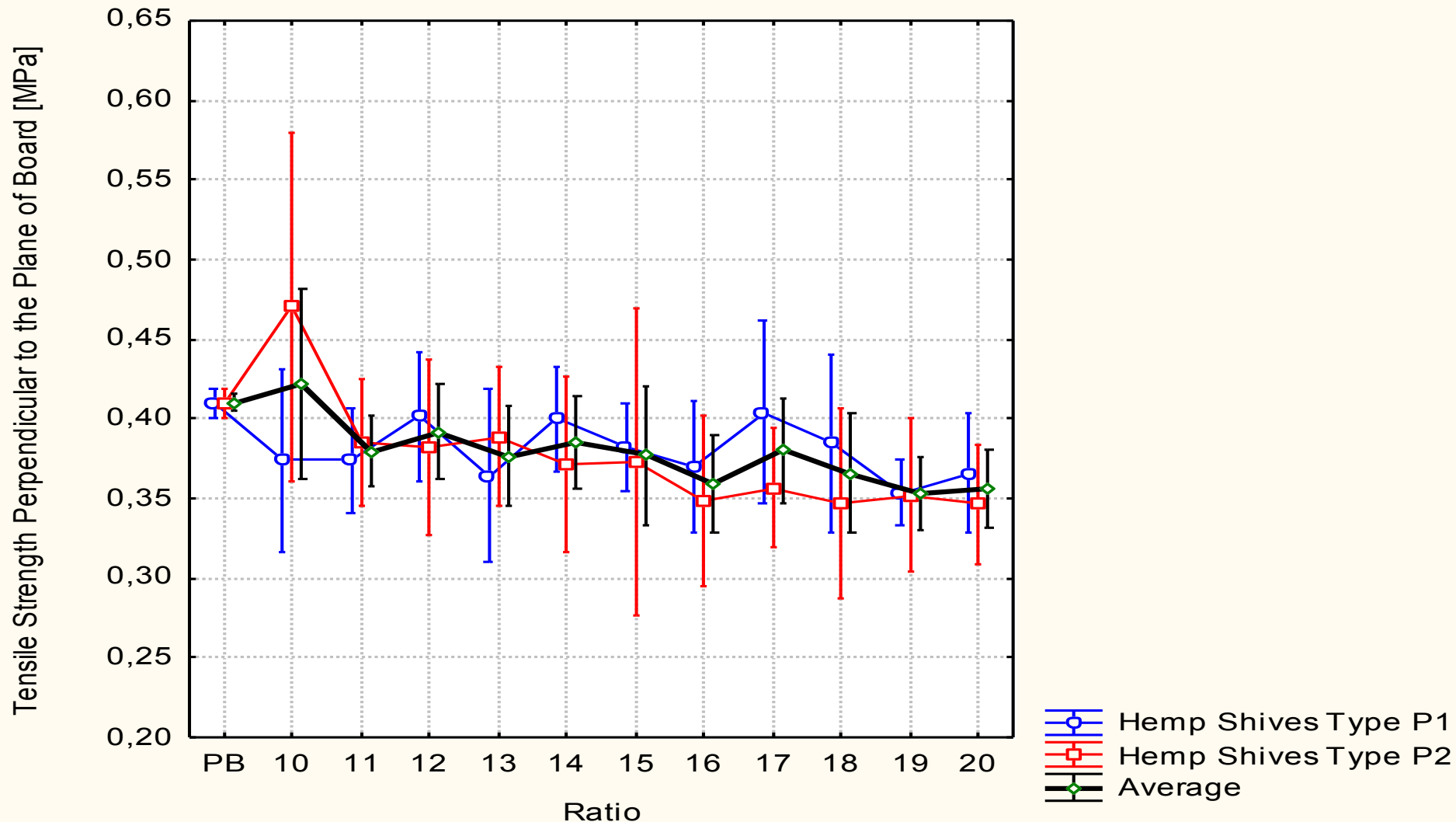
# Modulus of Elasticity in Bending Strength of 16 mm Particleboard



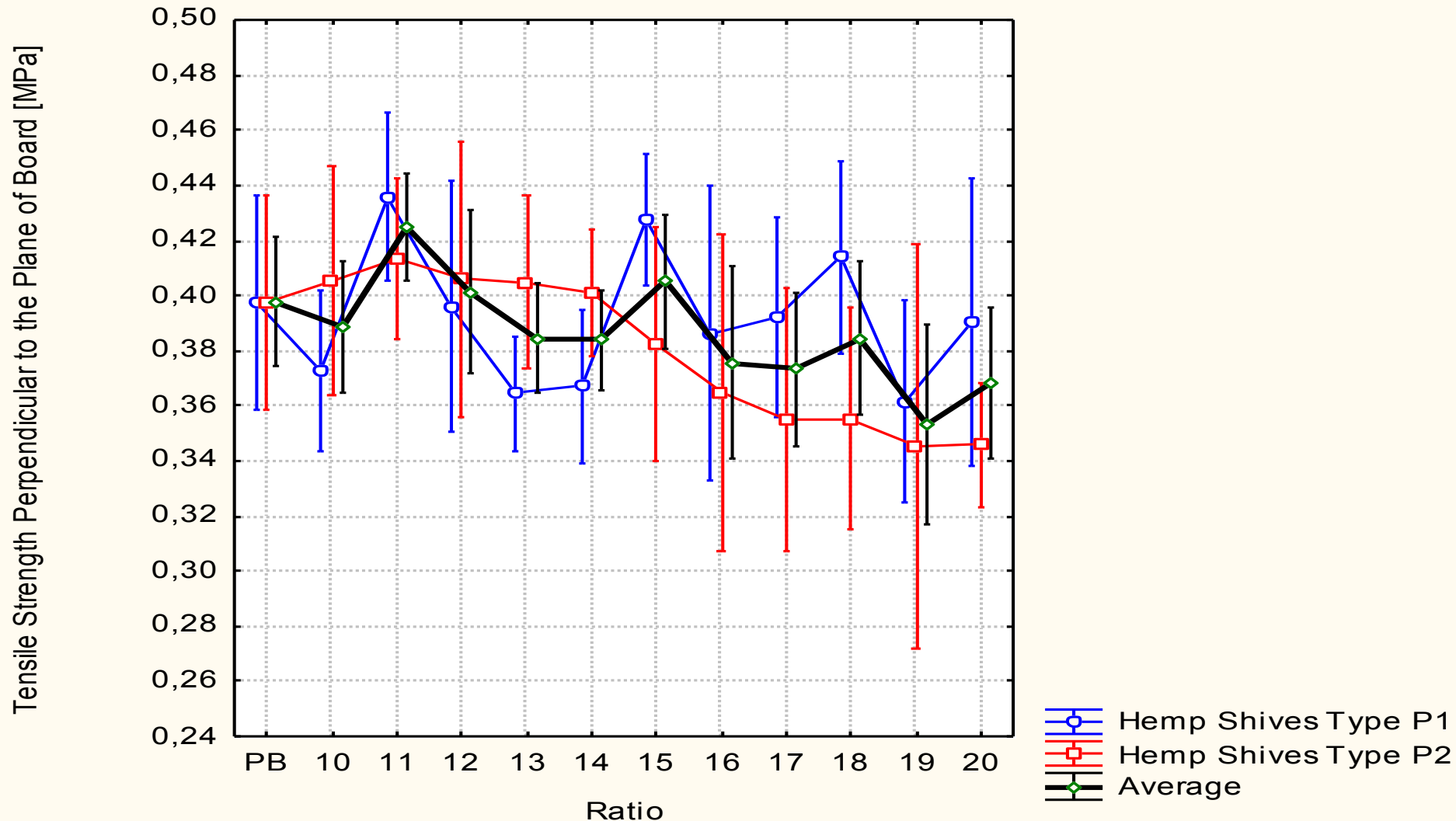
# Modulus of Elasticity in Bending Strength of 18 mm Particleboard



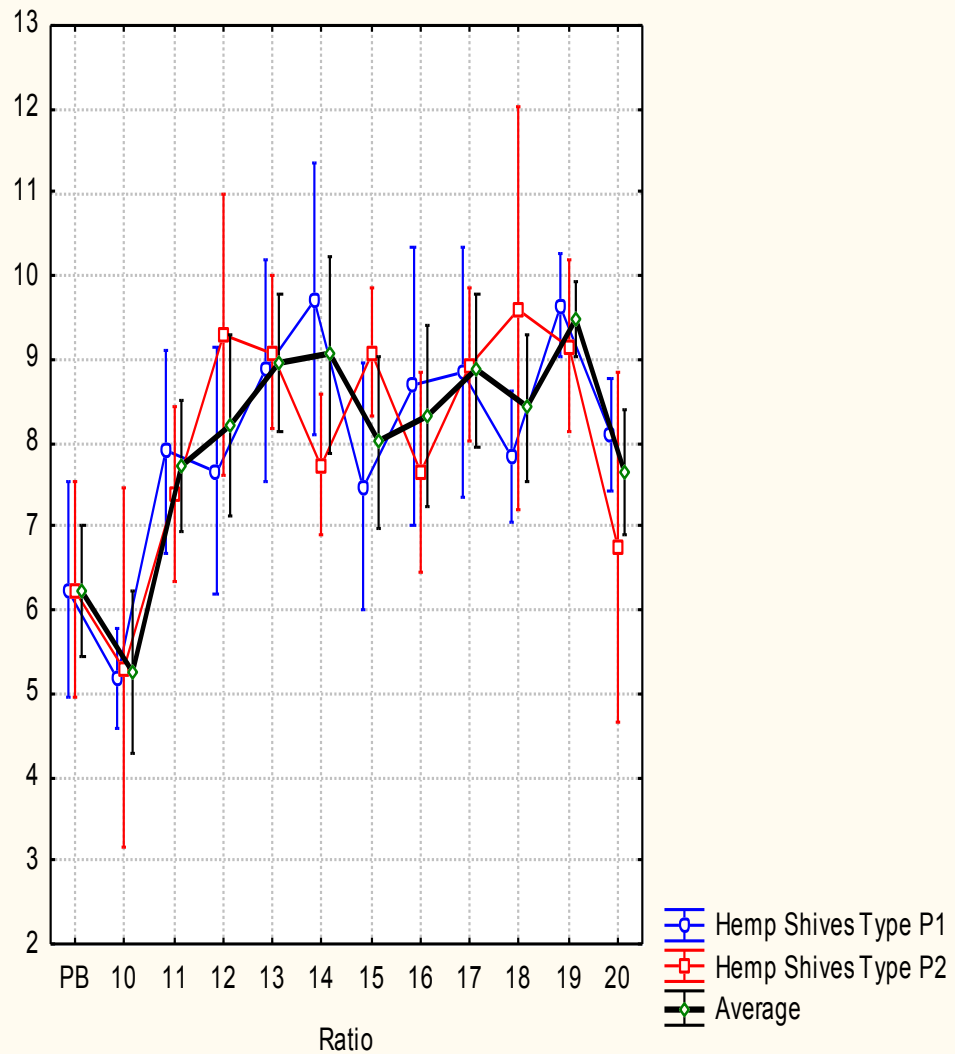
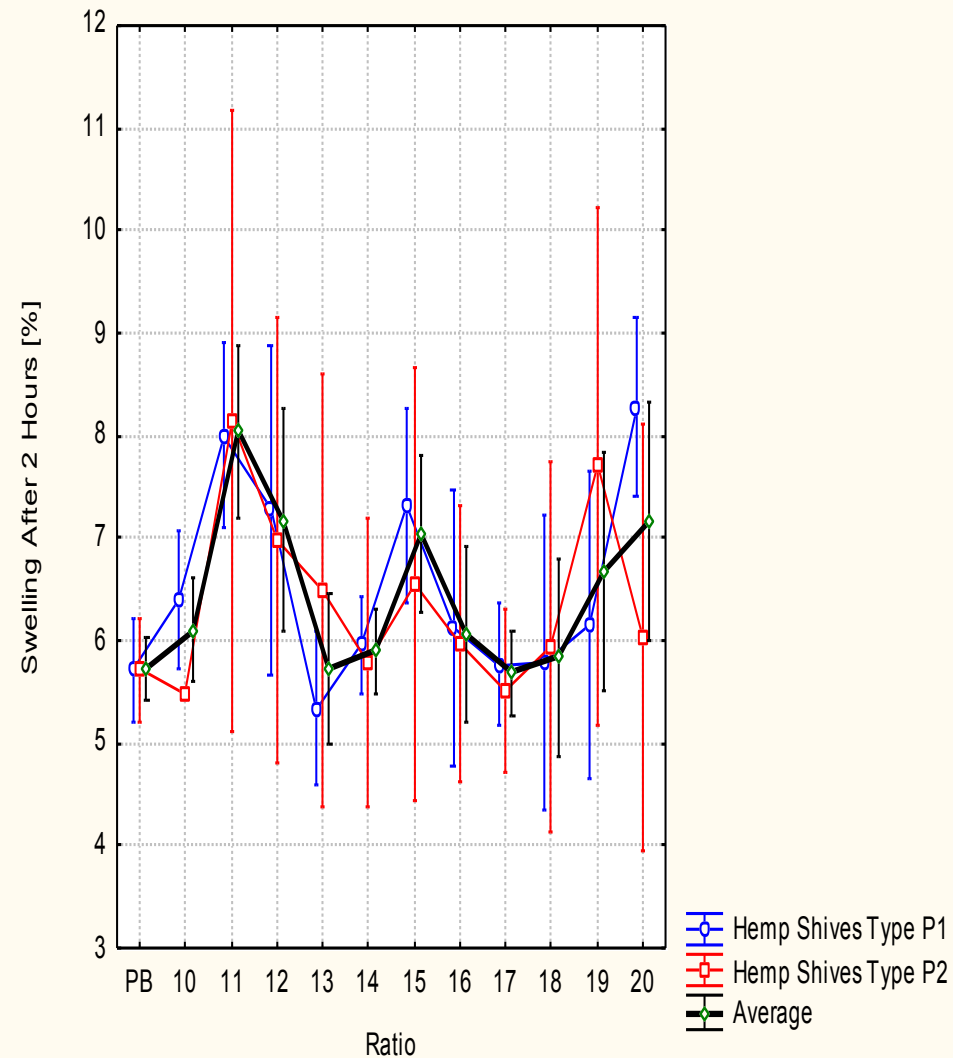
# Tensile Strength Perpendicularly to the Plane of 16 mm Particleboard



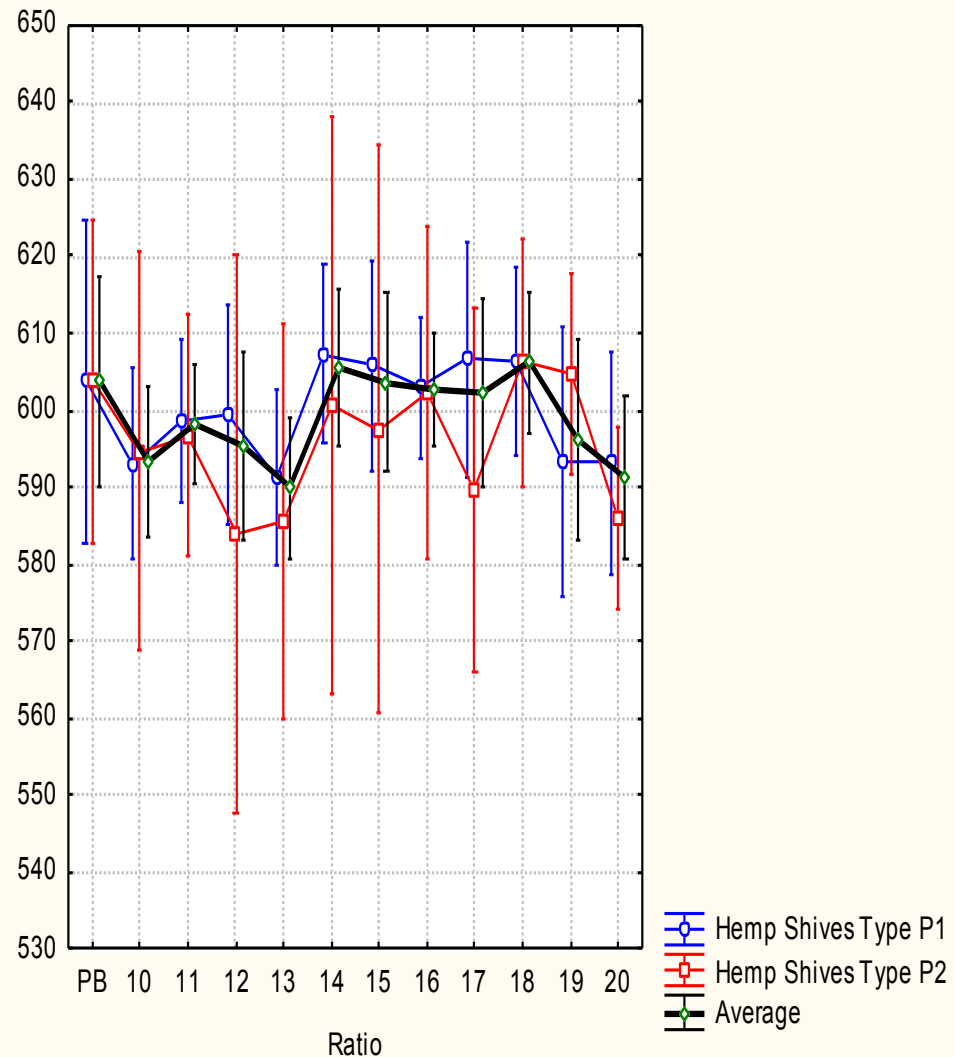
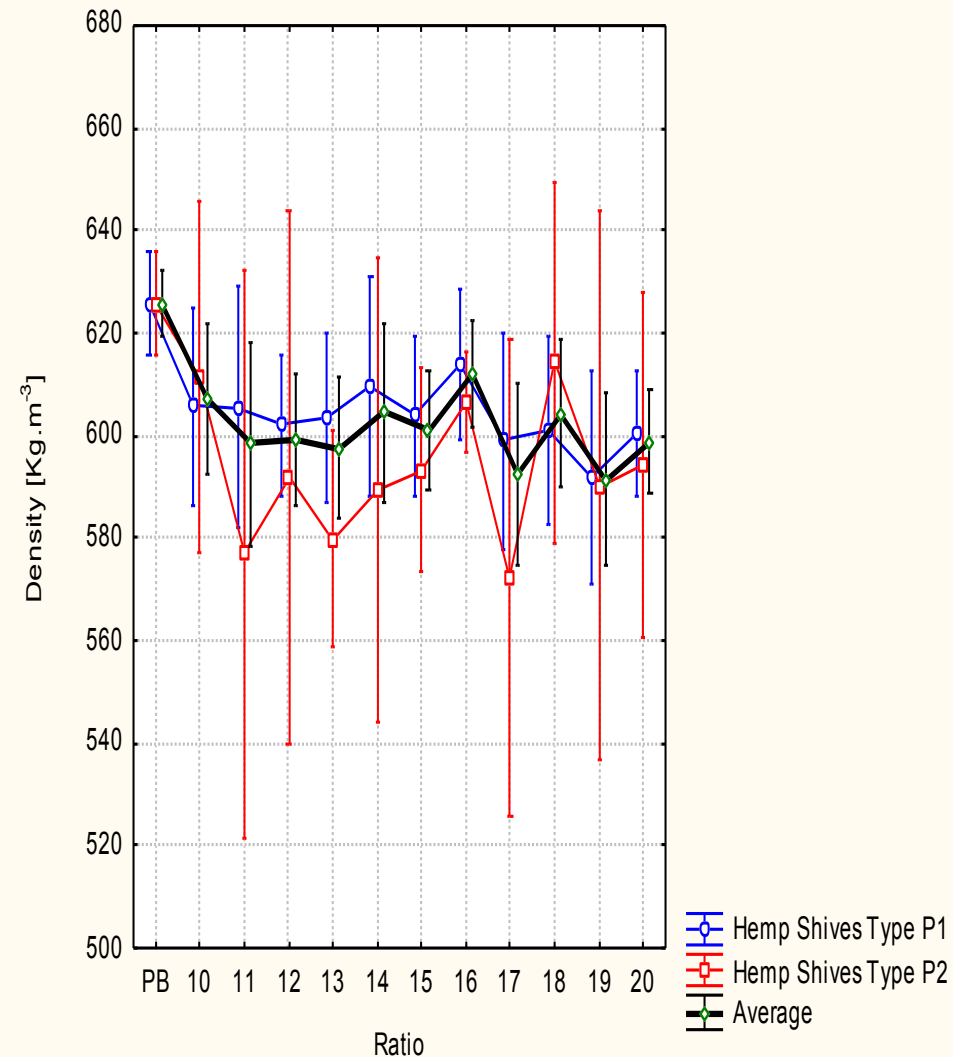
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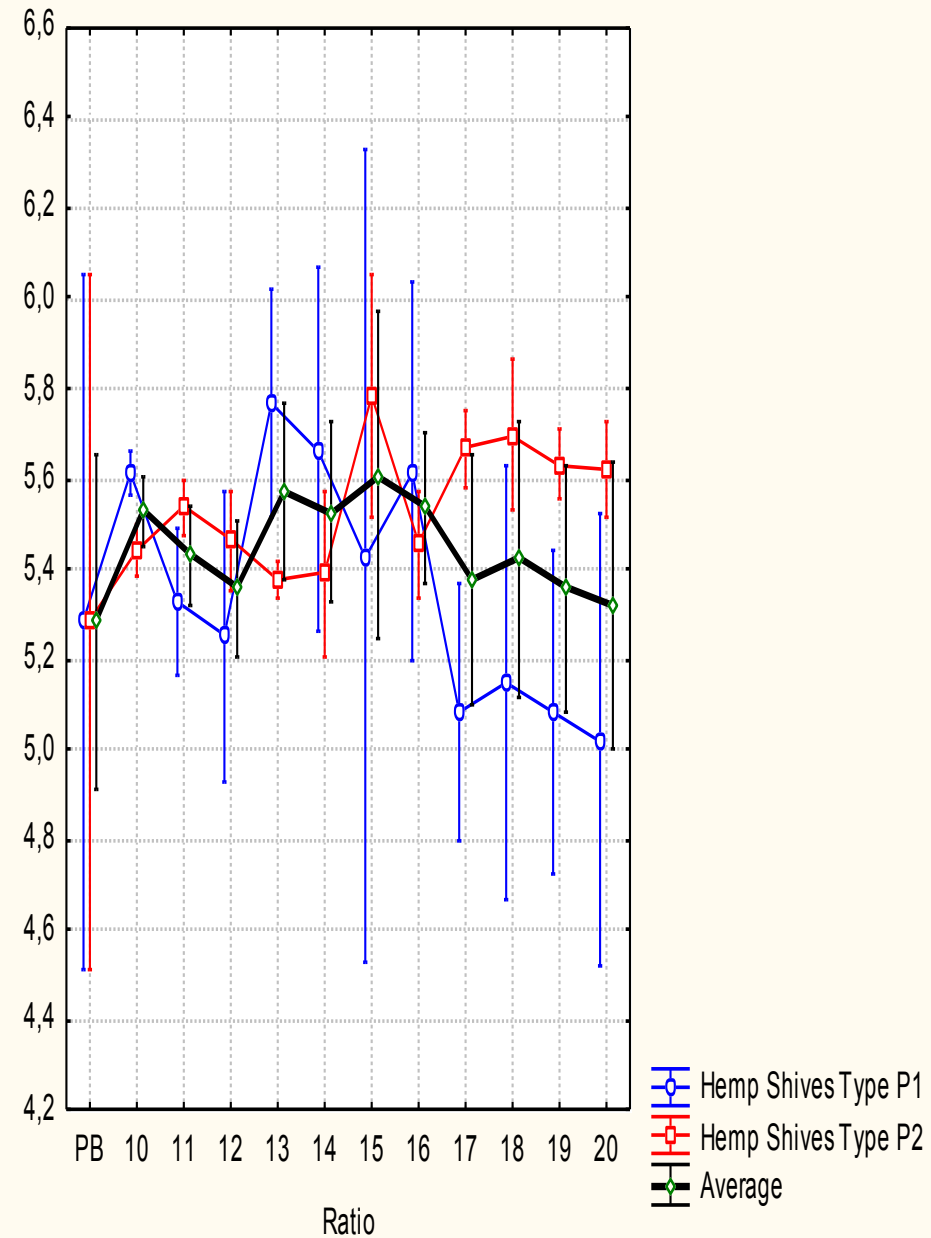
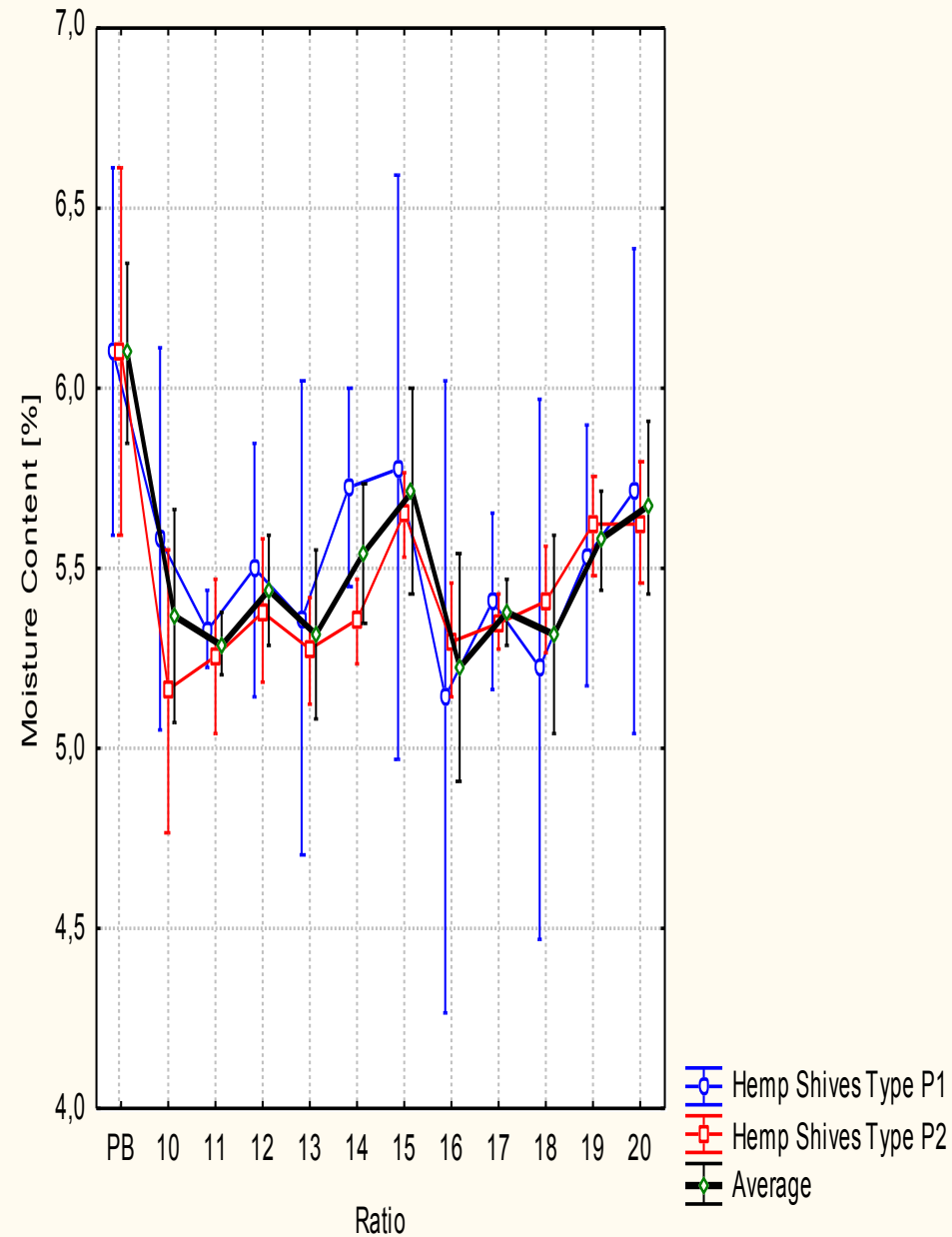
# Sweling After 2 Hours of 16 and 18 mm Particleboard



# Density of 16 and 18 mm Particleboard

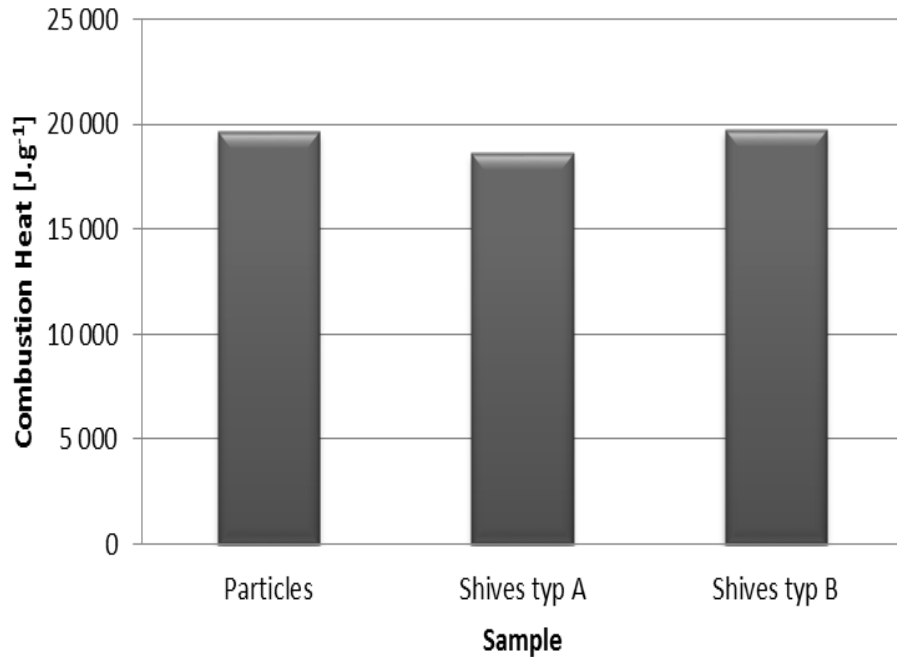


# Moisture Content of 16 and 18 mm Particleboard

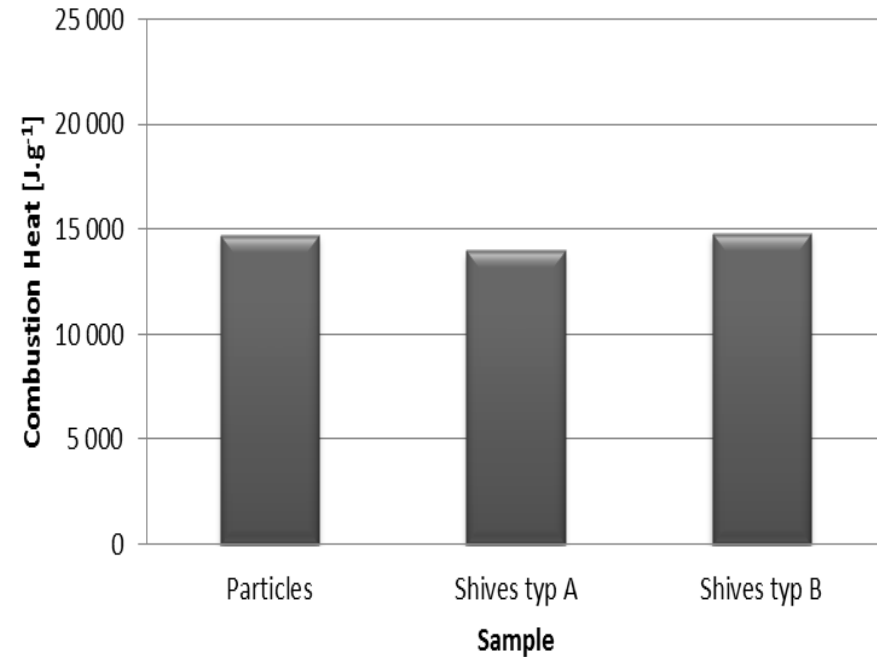


# Result of Combustion Heat

Combustion Heat



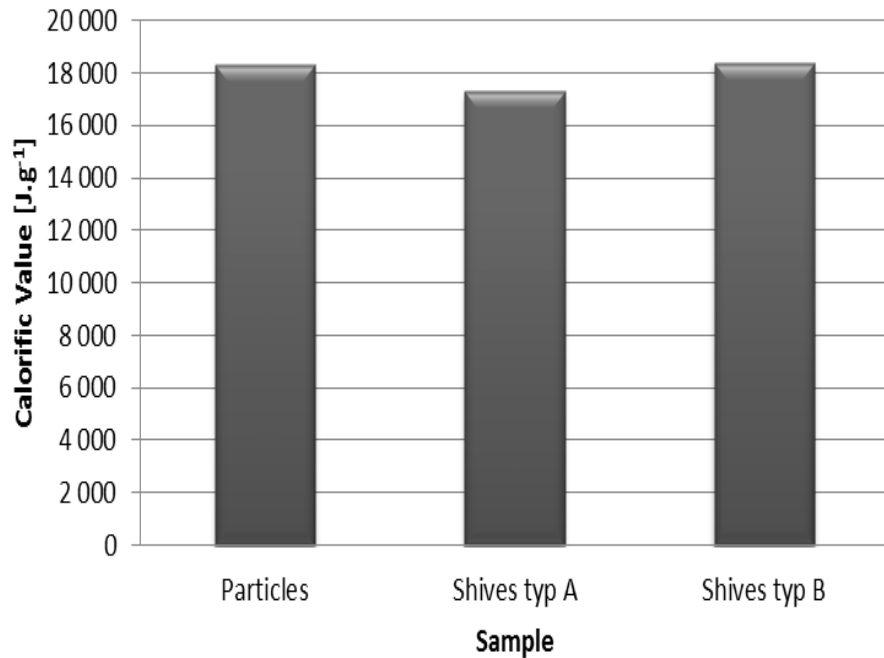
Combustion Heat MC = 25 %



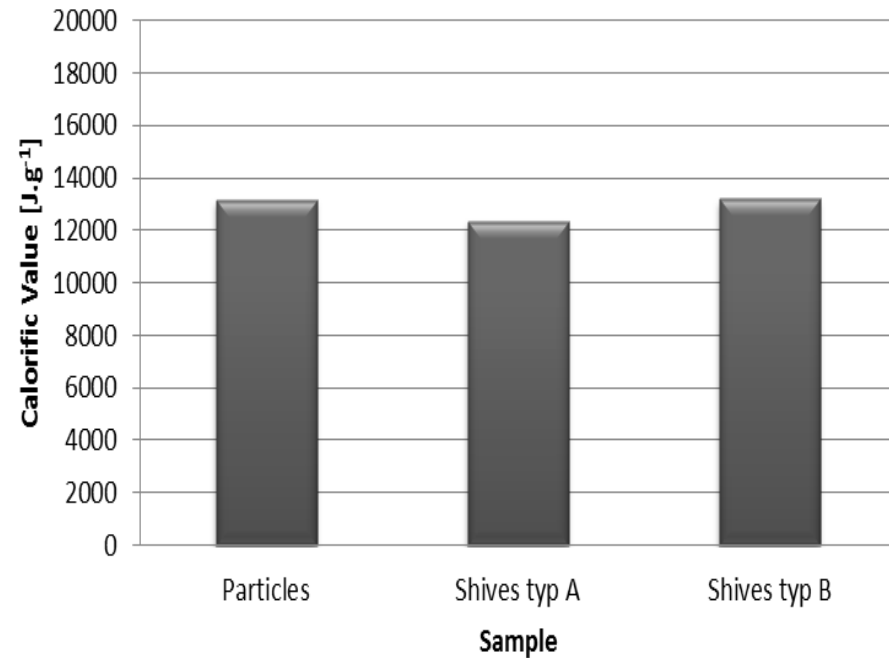
- combustion heat and calorific value of wood particles and hemp shives are about the same level
- result was confirmed in both mixtures
- fractional composition, was fully satisfied for the requirements of the particleboard manufacture

# Result of Calorific Value

## Calorific Value

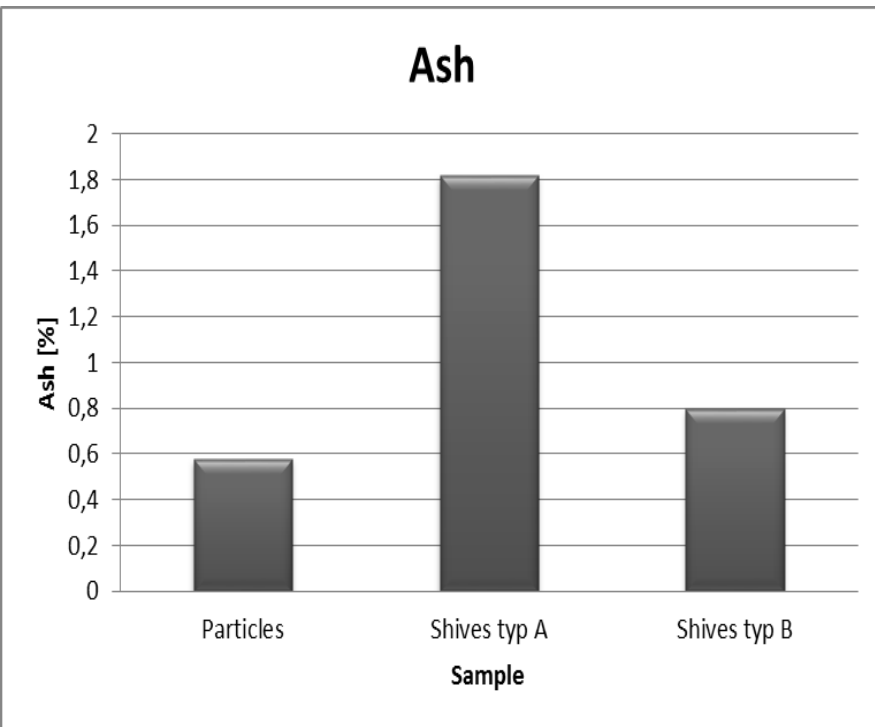


## Calorific Value MC = 25 %



- experiment was performed consequently with the mesh size fraction which is equal to 0.5 mm
- combustion heat and calorific value of wood particles compared with hemp shives were also in this case at a similar level

# Result of Ash Content



- hemp shives primary intended for animals bedding is **similar** to wood particles
- hemp shives previously used for the production of hemp boards have higher values of ash content resulting from „ageing“

- this fact can be consequently reflected in the determination of minerals content in the evaluation of the properties of ready-made particleboard
- increased content of minerals in the particleboard is undesirable in terms of blunting of cutting tools in the processing of particleboard for furniture or construction components

# Conclusions

- addition of maximum 20 % of hemp shives in the particleboard core layer of 16 or 18 mm **will not influence the properties of particleboard**
- it is possible to produce particleboard with the substitution of wood particles in their core layer with maximum 20 % of hemp shives **without the change of the technical and technological production parameters**
- the idea of the addition of hemp shives in particleboard is in harmony with the results of other authors
- physical and mechanical properties as well as fire-technical properties of particleboard with incorporated hemp shives in their core layer are **same or similar in comparison with normal particleboard**

# Partnership of the Research 2009-2012

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Bučina DDD, spol. s r.o., Zvolen, Slovakia

## Thank you for your attention.

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# **Pod'akovanie**

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