Rapeseed Morphology Parameters Influencing Oil Pressing

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1. Introduction

During the rapeseed oil pressing process, changes of oil yield and energy consumption can be observed although no process modifications are done.
Due to the known correlations between the thickness of the seed hull and the color of the seed, it is assumed that the diverse morphological properties of a single rapeseed particle are responsible for this phenomenon.
One asks already for many years whether there are differences while pressing or extracting the oilseed rape, which are based on the morphology, structure or hardness of the seeds, the strength of cell walls and the thickness of the seed hull?
Therefore investigations on the influence of different morphological parameters on rapeseed processing were performed.
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2. Materials and Methods

14 kind of rapeseeds were used. Among them are 8 lines - 1 with high-oleic and 1 yellow seeded line as well as 6 hybrids. At first some morphological parameters of different rapeseed samples were determined, such as appearance, roughness, color and thickness of the hull (analyzed by microscope), particle size distribution (analyzed by using the “Camsizer” system), specific weight, ADL (acid detergent lignin) and ADF (acid detergent fiber) as well as the oil content.
The ADL- and ADF content was determined by near infrared spectroscopy. Roughness and appearance were once detected optically by microscope and the other with the angle of repose method. Also the color was detected visually (subjective) because no suitable method could be found.
In order to investigate correlations between one or more morphological properties and oil yield, quality as well as energy consumption; pressing trials, using the same rapeseed samples, were performed.

3. Results

Figure 1 shows the dependence of seed weight on particle size.

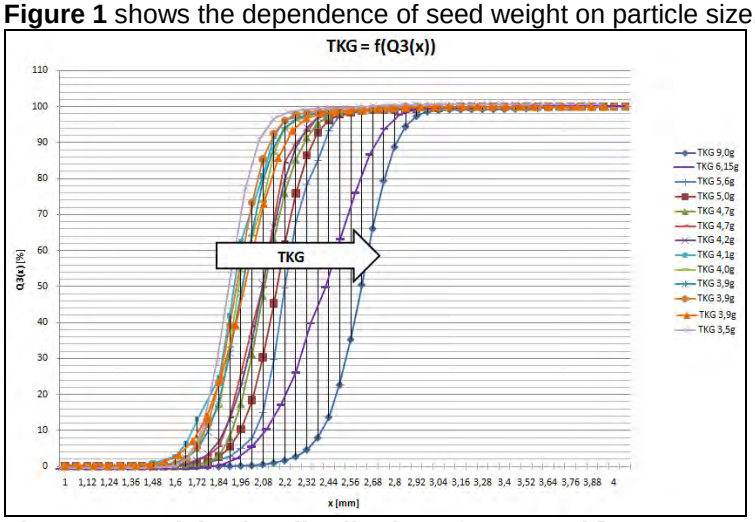


Figure 1: Particle size distribution of rapeseed [Otto-von-Guericke-University, Magdeburg]
TKG…Thousand seed weight
x… particle size

To study the hull thickness, microsections were made of each seed species and examined microscopically. **Figure 2** shows two pictures of them, where differences in the hull thickness between grains from one seed can be seen.

Due to the large differences in thickness among species and grains, the hull thickness is not an appropriate determinant.

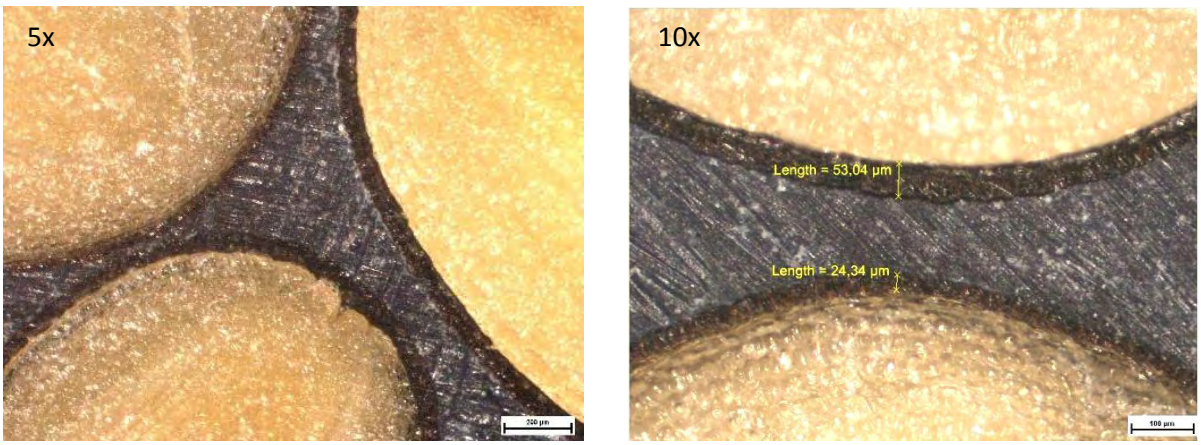
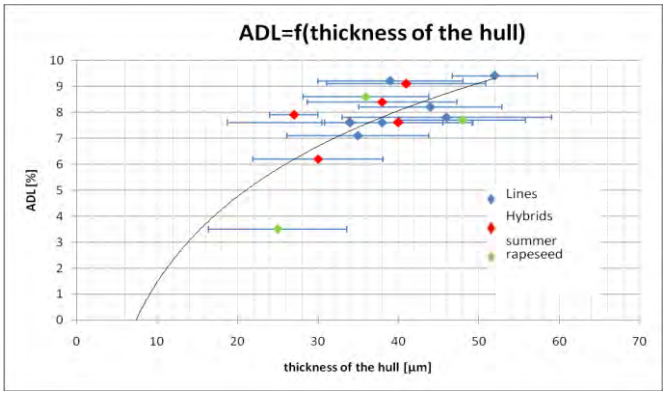


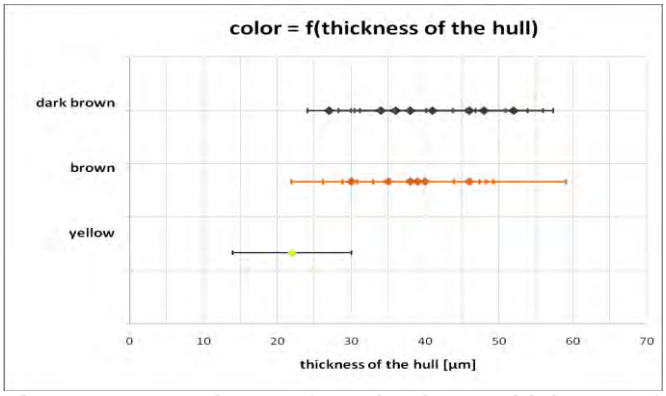
Figure 2: Microscopy from rapeseed cut, both pictures shows one kind of seed [Otto-von-Guericke-University, Magdeburg]



Great variations in thickness
→
no significant correlation between fiber content and the thickness of the hull.

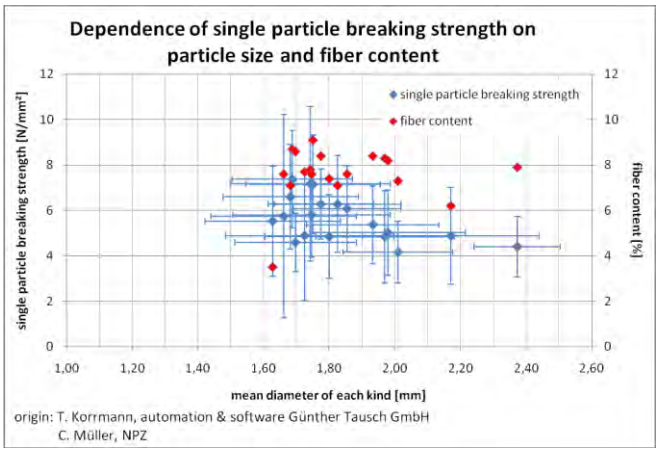
Tendency: Thicker hulls have a larger

Figure 3: Fiber content as influencing parameter of the thickness of the hull [NPZ, Holtsee, Germany]



There are dark brown seeds, with the same thickness of the hull, as brown and yellow colored seeds. Detecting the color does not provide additional information about the hull thickness.

Figure 4: Dependence of seed color on thickness of the hu



There is no correlation between fiber content and single particle breaking strength.

Tendency: Lower breaking strength with increasing diameter.

Figure 5: Dependence of single particle breaking strength on particle size and fiber content

Energy consumption and oil yield

During laboratory tests, the energy consumption was measured at two oil presses at two different processing speeds. After performing those tests, the varieties in ascending order are arranged according to their energy consumption. The same order is obtained from a ratio equation with the parameters of moisture, TKG and hull thickness. The yield of oil was determined from the press cake and converted in a relative oil yield.

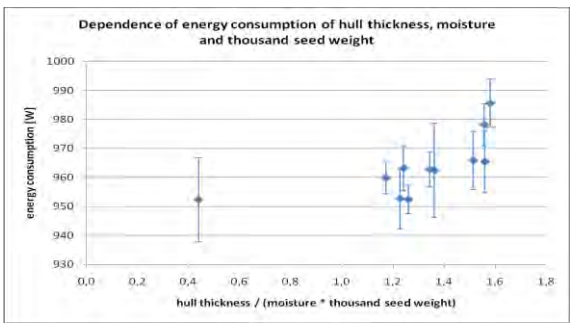


Figure 6: Dependence of energy consumption

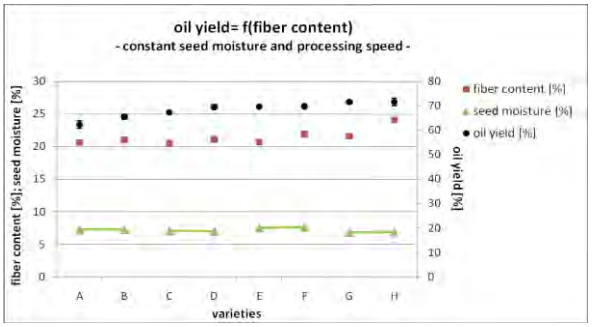


Figure 7: Dependence of oil yield

4. Discussion

Besides the relation between the particle weight and the particle size, no other significant correlation could be verified. The rule is: The larger the grain, the heavier.
Until now, no correlation could be proven neither between the particle weight and the oil content, nor between the surface appareance/ roughness and single particle fracture resistance.

The energy consumption of an oil press tends to be higher, the thicker the hull, the bigger and wetter the grain.
Furthermore the energy consumption is lower, the slower the processing speed is.

The experiments show that the relative yield of oil depends on the compression rate – which means the lower the speed, the greater the relative oil yield.
If the processing rate is constant, the relative oil yield is influenced by another two factors:

1. The seed moisture content
2. The fiber content of the seed.

If the moisture of the seed is constant, the fiber content is the most important parameter to regulate the oil yield. If the dependence of the oil yield on the fiber content at constant seed moisture is known for a couple of different varieties, it will be able to estimate the yield of oil of other varieties to ±2% absolutely.
The rule is: The lower the seed moisture and the higher the fiber content, the greater the relative oil yield.