

# Selected factors influencing breakage of biomass grains during processing

Dr Weronika Kruszelnicka, Bydgoszcz University of Science and Technology, Bydgoszcz, Poland (presenter)

## Abstract

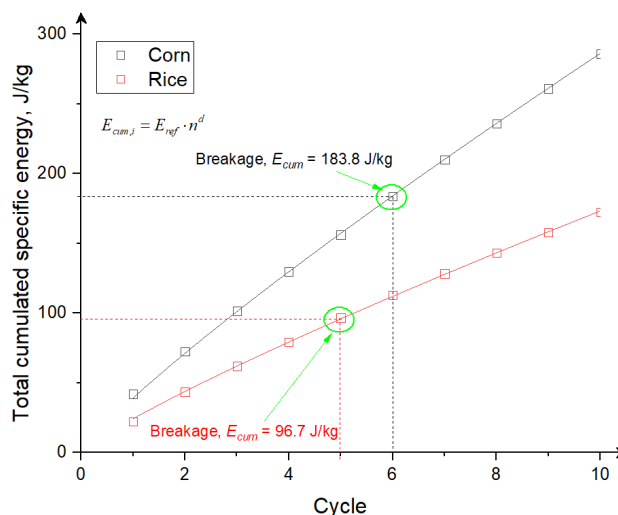
**Statement of the Problem:** Each year millions tons of cereals and other biological grains are processed for feed and non-feed purposes (ex. polymers production, pharmaceutical production, cosmetics industry). Only in the 2023/2024 it is expected that 2.28 mld t of cereals will be harvested globally. During handling and processing a lot of grains are lost due to damage (even up to 25%) and as evidenced for corn [4] about 6.6% is mechanical damage in the form of broken or chipped kernels. To prevent and decrease the mechanical damage it is necessary to study the breakage and factors that influence the breakage.

On the other hand, the significant amount of kernels is subjected to particle size reduction processes or extraction, where the principal process is breakage and comminution. The major problem of those processing operations is the lack of control on the breakage, especially on the particle size of product and high energy consumption. The understanding of the breakage of grains will improve the energy efficiency of comminution and allow to generate the product with the desired particle size and composition.

The aim of the presented research was to deepen knowledge about the factors influencing the probability and course of breakage of biomass grains for the purposes of modeling and optimization of processing and design features of machines. Using the example of rice and corn grains, the influence of selected material factors and operating conditions on the breakage probability was explained.

**Conclusion & Significance:** The influence of selected factors on the biomass grains breakage was described. This allow to understand the breakage mechanisms of cereal grains during processing operations, which constitute the basis for deriving a mechanistic model of grains breakage necessary in the design of low-waste and high-efficiency devices. In a broader context, achievements in the improvement of processing will lead to: reduction of greenhouse gas emissions from waste, reduction of food poverty by proposing a model useful in the construction of machines, allowing for the reduction of grain losses during processing and increase in efficiency of comminution and extraction processes.

## Image



**Figure 1.** The dependence between number of compressive cycles and total cumulated specific energy for rice (compression force=30 N, MC = 12,8%) and corn grains (compression force=240 N, MC = 8,2%)

## Recent Publications

1. Globalny rynek zbóż i nasion oleistych - listopad 2023 – Agronomist. <https://agronomist.pl/artykuly/globalny-rynek-zboz-i-nasion-oleistych-listopad-2023> (accessed 2024-03-20).
2. Mesterházy, Á.; Oláh, J.; Popp, J. Losses in the Grain Supply Chain: Causes and Solutions. Sustainability 2020, 12 (6), 2342.
3. Kruszelnicka, W.; Leda, P.; Tomporowski, A.; Ambrose, K. Breakage Behavior of Corn Kernels Subjected to Repeated Loadings. Powder Technol. 2024, 435, 119372.
4. U.S. Grains Council. 2022 ANNUAL REPORT. 2022 ANNUAL REPORT. <https://grains.org/2022-annual-report/> (accessed 2024-04-15).
5. Kruszelnicka, W. Study of Selected Physical-Mechanical Properties of Corn Grains Important from the Point of View of Mechanical Processing Systems Designing. Materials 2021, 14 (6), 1467.
6. Kruszelnicka, W.; Chen, Z.; Ambrose, K. Moisture-Dependent Physical-Mechanical Properties of Maize, Rice, and Soybeans as Related to Handling and Processing. Materials 2022, 15 (24), 8729.

## Photograph



## Biography

Dr Weronika Kruszelnicka is an Assistant Professor at the Department of Renewable Energy Sources Engineering, Faculty of Mechanical Engineering at Bydgoszcz University of Science and Technology. Her major interest is the breakage phenomenon of biomass grains and the improvement of the comminution machine design, as well as improvement of the energy-environmental performance of comminution devices. She has published over 90 publications, has been the principal investigator of the projects funded Polish Ministry of Science and Higher Education, National Science Center and Polish National Agency for Academic Exchange. She has completed research internships in the United States of America, Czech Republic and Ukraine. She is a laureate of many awards: medals for inventions, twice scholarship from the Mayor of the City of Bydgoszcz, the thrice scholarships from Ministry of Science and Higher Education and START scholarship from Foundation for Polish Science.

Email: [weronika.kruszelnicka@pbs.edu.pl](mailto:weronika.kruszelnicka@pbs.edu.pl)