



Laboratory of Agglomeration

- I. Location of the laboratory:
Research, Education and Innovation Centre of Earth and Environmental Science,
University of Miskolc, building C/2
- II. Operating Institute of the laboratory
Institute of Raw Materials Preparation and Environmental Technology
- III. Scientific head of the laboratory:
Prof. Dr. Barnabás Csőke, professor emeritus
3515 Miskolc-Egyetemváros, A/4, II. 207.
Telephone: +36-46-565-111/2273;
- IV. Responsible person for the laboratory:
Dr. Sándor Nagy, Head of the Institute, Associate professor
3515 Miskolc-Egyetemváros, A/4, II. 201.
Telephone: +36-46-565-111/1979;
- V. The aims and tasks of the laboratory on the education (BSc, MSc), scientific and research fields:
Particle size enlargement is used in various industries, from ore preparation to food-, pharmaceuticals-, ceramics-, chemicals-, waste preparation, agriculture. Granulated form has several advantages over the powder form. Pressure agglomeration can be carried out in the laboratory using piston presses, roller presses (compactors), and flat die pelletizers. Growth agglomeration can be performed with balling pan.

Subjects list related to the laboratory:

- Fundamentals of Process Engineering
- Comminution and agglomeration
- Mineral processing
- Processing and recycling of municipal solid wastes
- Agglomeration of fine materials

The laboratory also provides the infrastructural background for theses and dissertations related to the topic of agglomeration, and in addition to BSc and MSc courses, it also provides tasks related to professional training and PhD studies.

Tasks of education and research:



- Laboratory exercises for students, in both BSc and MSc.
- Manual training for postgraduate courses
- Laboratory background for PhD works
- Laboratory background for domestic and international R&D programs

The equipment often participates in Researchers' Night, University's Open Day, Girls' Day events to showcase the teaching and research at the Faculty of Earth Sciences. The laboratory also plays an important role in industrial research, commissions, and tenders.

VI. Laboratory experiments, and services (on-site experiment is possible):

Mineral processing mainly requires the agglomeration of ore powders and other minerals (e.g. coals). Today, there is a growing demand for solid fuels of agricultural origin (bio-pellets) and for fuels made from municipal solid waste (RDF/SRF). The raw material for pellets can range from sawdust, fibrous biomass (e.g. wheat straw), vegetable by-products of biodiesel and bioethanol production, and sewage sludge to RDF/SRF. There is also a significant need for shredding and briquetting of various wastes (e.g. plastic waste, shredder residues, hazardous dust, certain fractions of municipal solid waste, sewage sludge, and other low-density materials) for better handling (transport, feeding, dumping), better combustion properties and protection against spillage.

- The institute's piston press can be used to make experimental tablets at different pressures and temperatures and to model the agglomeration process. The piston of the machine is equipped with a force and distance meter to calculate the agglomeration work. It is possible to determine density and strength of the tablets produced (within the Faculty of Earth and Environmental Sciences and Engineering). Many experiments can be carried out with the press at different parameters, allowing reliable determination of the main parameters with a small sample requirement.
- Flat die pelleting system has a mixer, conditioning auger and steam generator. It can be used to model industrial-scale pellet mills for different feedstock (e.g. agricultural waste, wood chips, municipal solid waste, other secondary raw materials, etc.).
- The existing complete pilot scale compacting technology is suitable for the compaction of powders, even in a continuous process plant.
- During the growth agglomeration process (pelletization), the particles of solid material roll together in the presence of moisture (binder) and form larger and larger agglomerates. The equipment for this process is the balling pan.
- In the laboratory, the qualification of solid biomass fuels can also be carried out: determination of particle size fraction mass fractions on round hole sieve grids,



estimation of bark content, maximum particle length, and maximum particle cross-section).

VII. Laboratory equipment, list of main equipment with technical characteristics:

Laboratory hydraulic piston press

Hydraulic piston press – technical parameters	
F _{max}	200 kN
V _{max}	30 mm/s
Temperature range	20 - 140 °C
Diameter of tablets	25 ill. 40 mm
Distance measurement	Incremental
Data processing (force, distance)	PC, LabWindows

Complete compactor with data acquisition system (compacting cylinder)

Complete compactor – technical parameters	
diameter of cylinder	200 mm
width of cylinder	80 mm

Flat die pellet system

The system includes a mixing tank, a conditioning screw, and a steam generator unit in addition to the press.

Flat die pellet – technical parameters	
Complete unit manufacturer, assembler	Classicmechanik Ltd, Székesfehérvár
Main units	Mixing tank Conditioning auger Steam generator Pelletizer
Type	ZLSP200B
Engine power	7,5 kW
Pelletizer capacity	110-180 kg/hour
Pelletizer sticker diameter	200 mm
Sticker hole sizes: 6 mm	6, 8 and 10 mm

Balling pan (Pelletizer)

The balling pan has a diameter of 400 mm, adjustable angle of inclination and speed.

VIII. Laboratory development, plan and needs:



Purchase of additional equipment in the agglomeration area: microgranulator (planned in SciencePark project). Purchase of a pilot scale piston press for the production of rod briquettes.

IX. Key professional partners:

The laboratory is in contact with a number of industrial and academic partners, with whom we carry out project work and industrial assignments.

- 3B Hungária Ltd.
- Dunántúli Regionális Vízmű Zrt.
- Vertikál ZRt. (Polgárdi)
- Profikomp Ltd. (Gödöllő)
- TU Paderborn
- Technische Universität Magdeburg

International projects

TU Paderborn - Un Miskolc: Untersuchungen zum Fördern und Kompaktieren staubförmiger Stoffe in Hochleistung-Walzenpressen. U/No.CIPA-CT93-0151. 1994-1997. Projektleiter: Prof. Dr. M. PAHL, TU Paderborn; Prof.Dr. I. TARJÁN, Universität Miskolc, Themenleiter (in Miskolc): Prof. Dr. B. CSŐKE

TU Paderborn - Universität Miskolc: Dosierung und Kompaktierung von staubförmigen Stoffen in Walzenkompaktoren. 2001-2002/21. Projektleiter: Prof.Dr.M. PAHL, TU Paderborn und Prof.Dr. I. Prof. Dr. B. CSŐKE, Universität Miskolc

Bewertung der Pressagglomeration auf der Basis der Schüttguteigenschaften, MÖB-DAAD 2002/2003. Universität Miskolc – Technische Universität Magdeburg. Projektleiter: Prof. Dr. J. TOMAS, TU Magdeburg und Prof.Dr.B. CSŐKE Barnabás, Univ. Miskolc

Miskolci Egyetem, NYKE, NML - National Metallurgical Laboratory: Geopolimer tulajdonságainak szabályozása pernye mechanikai aktiválásával. Magyar – indiai Együttműködés 2011-2012 program. TÉT_10-1-2011-0296

Domestic projects

Thematic Programme of Excellence: more efficient exploitation and use of underground natural resources - TUDFO/51757/2019/ITM



Development of a bio raw material product range taking into account the local technology line - feasibility studies with optimisation of operating conditions - GINOP-2.2.1-15-2017-00069

PIAC-13: Market-oriented research and development of an innovative, environmentally friendly insulating material using polystyrene as a secondary raw material (project leader, University of Miskolc: Dr. Gábor Mucsi)

Recovery of lead-containing glass waste from cathode-ray screens for the construction industry. TECH_08-A4-CRTGLASS. (project leader, University of Miskolc: Prof. Dr. Barnabás Csőke)

Developing technologies for the recovery of organic materials from scrap cars and electronic waste to avoid future landfilling (RECYTECH), NTP TECH_08_A4 / A sustainable environment, 2009-2011.

GOP-1.1.2-08/1-2008-0002 / Environmental technologies, recycling. 2010, theme: Production of refined fuels from municipal solid waste

Developing innovative, sustainable energy products and technologies. NKFP-A3-2006-0024 (Jedlik Ásnyos), 2007-2009 Project leader: Dr. Alexa László Managing Director, Profikomp Kft., Gödöllő, subcontractor

Utilisation of Municipal Solid Waste with the Production of Alternative Fuels Meeting International Standards, GVOP-3.1.1.-2004-05-0460/3.0 2004-2007, (Project leader, University of Miskolc: Prof. Dr. Barnabás Csőke)

Research and development to lay the foundations for domestic carbon bio-briquette production. NRCP call (OM). ENE-00007/03. Applicant: Department of Environmental Chemistry and Chemical Technology, ELTE. Application amount: 14.000 eFt; of which Institutional part:: 7.000 e Ft. Project leader: Prof. Dr. Gyula Záray, Professor, ELTE; in Miskolc: Prof. Dr. Barnabás Csőke, Professor.

Main publications related to the activities of the laboratory

Trinh, Quyen V. ; Nagy, Sándor ; Faitli, József ; Csőke, Barnabás: Determination of radial pressure distribution on the wall of the press channel of a novel biomass single die pelletiser. EUROPEAN JOURNAL OF WOOD AND WOOD PRODUCTS 78 : 6 pp. 1075-1086. , 12 p. (2020)



Nagy, Sándor ; Trien, Quyen ; Dóra, Gábor: Influence of temperature on pur briquetting. In: Tibor, Kiss; Anita, Dolgosné Kovács; Csaba, Vér; Péter, Máthé (szerk.) Sustainable resource management : Scientific conference proceedings. Pécs, Magyarország : University of Pécs Faculty of Engineering and Information Technology, (2019) pp. 59-65. , 7 p.

Quyen, V. Trinh ; Sándor, Nagy ; Barnabás, Csőke: DETERMINATION OF APPLIED PRESSURE ON BIOMASS DURING PELLETIZING BY HYDRAULIC PISTON PRESS. In: Gábor, Rákhely; Cecilia, Hodúr (szerk.) II. Sustainable Raw Materials Conference Book - International Project Week and Scientific Conference. Szeged, Magyarország : University of Szeged, (2019) pp. 55-61. , 7 p.

Quyen, V. Trinh ; Sándor, Nagy ; Barnabás, Csőke: DEVELOPMENT OF A SINGLE PELLETISER UNIT TO MODEL BIOMASS RAW MATERIALS PROCESSING IN FLAT DIE PELLETISERS. In: Gábor, Rákhely; Cecilia, Hodúr (szerk.) II. Sustainable Raw Materials Conference Book - International Project Week and Scientific Conference. Szeged, Magyarország : University of Szeged, (2019) pp. 127-136. , 10 p.

Trinh, Van Quyen ; Nagy, Sándor: The influence of temperature on the briquetting of ground post-agglomerated spelt chaff. BIOHULLADÉK 13 : 1 pp. 15-18. , 4 p. (2019). Tudományos

Trinh, Van Quyen ; Nagy, Sándor: Agglomeration of various biomasses. In: Tibor, Kiss; Anita, Dolgosné Kovács; Csaba, Vér; Péter, Máthé (szerk.) Sustainable resource management : Scientific conference proceedings. Pécs, Magyarország : University of Pécs Faculty of Engineering and Information Technology, (2019) pp. 76-82. , 7 p.

Trinh, Van Quyen ; Sándor, Nagy: AGGLOMERATION OF ACACIA MANGIUM BIOMASS. Vietnam Journal of Science and Technology 56 : 2 pp. 196-207. , 10 p. (2018)

Trinh Van Quyen, Sándor Nagy: Effect of temperature and particle size on beech biomass agglomerates. MultiScience – XXX. microCAD International Multidisciplinary Scientific Conference Proceedings. University of Miskolc, 2016.

Trinh Van Quyen, Sándor Nagy: Development of single pelletizer unit for modelling flat die pelletizer. MultiScience – XXX. microCAD International Multidisciplinary Scientific Conference Proceedings. University of Miskolc, 2016.

S. Nagy: Agglomeration of Different Agricultural Wastes. Proceedings of the 18th international conference of waste recycling. University of Miskolc, 2014.

Nagy S.: Szelektíven gyűjtött papírhulladék illetve fűrészpor és faforgács tablettázhatóságának vizsgálata. Biohulladék 7. évfolyam 1. szám, 2013. március, p22-25, ISSN 2062-8811



Nagy S., Cseppely V.: A nagy fűtőértékű MBH termék további nemesítésének kísérleti vizsgálata (Hulladékonline, <http://folyoirat.hulladekonline.hu/>, 2012. február)

Szűcs I., Nagy G., Palotás Á., Csőke B., Nagy S., Boros É.: Biomassza és szilárd települési hulladék alapú másod tüzelőanyag kifejlesztésének időszerűsége / Timeliness of developing a biomass and solid residential waste based additional fuel. Anyagmérnöki Tudományok, Miskolc, 36/1 kötet, (2011)

Nagy, S.: Agglomeration processes of fine powders used in metallurgy. ESCC 2009, 12th European Symposium on Comminution and Classification, Espoo (Finland), 15-18 September 2009 (Publ.: CD Proceeding 7B-2)

Nagy, S., Ferencz, K.: Tüzelőanyag előállítása a polgárdi pelletáló üzemben/Fuel production in the pellet plant located in Polgárdi, BIOhulladék/BIOwaste 2-3/2010, p18-22

Nagy, S.: Agglomeration of biomass and other wastes. Proceeding of the 1st Knowbridge Conference on Renewables, Miskolc September 27-28, 2010 (Publ.: University of Miskolc, ISBN: 978-963-661-944-2)

Csőke, B.- Faitli, J.: Experimental Study of the Compacting Phenomena in Roll Presses Using Screw Feed. Progress in Mining and Oilfield Chemistry, VOL.5. (Ed. Lakatos, I.) Akadémiai Kiadó (ISBN 963 05 7996 0, HU ISSN 1585-1176), Budapest. 2003, 413-424

Csőke, B.- Tarján, I.,- Faitli J.: Experimental Investigation of Compacting in Roll Presses with Gravity and Screw Feed. Proceedings of XXI. International Mineral Processing Congress. Rome, Italy. July 23-26, (Ed. Massacci, P.), Elsevier (ISBN 444 50283 1), Amsterdam, 2000., A4132-142

X. Other information for the assessment of the laboratory's activities:



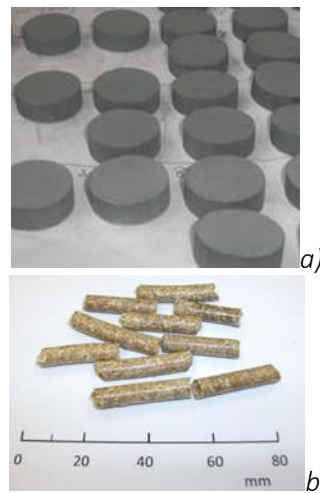
Hydraulic piston press



Flat die pelletizer



Balling pan



Products of piston press (a) and flat die pelletizer (b)

XI. The information material written by:

Dr. Sándor Nagy, Ildikó Fóris

Miskolc, 19 June 2024