Twinning for Promoting Excellence, Ability and Knowledge to develop advanced waste gasification Solutions

Project No: 951308

TwinPeaks

Summer school 2 training material

WP 4 – Task 4.2 / D 4.2

May 2023

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TWIN-PEAKS website: www.twin-peaks-h2020.com

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Abbreviations

CTH	Chalmers University of Technology
D	Deliverable
LEI	Lithuanian Energy Institute
TUM	Technical University of Munich
VMU	Vytautas Magnus University
WP	Work package
WtE	Waste-to-energy

1 Introduction

The overall objective of the TWIN-PEAKS project is to establish a research and innovation collaboration between LEI, VMU, TUM, CTH and WIP to raise the scientific excellence, capacities and international reputation of LEI and VMU in advanced waste gasification. That imposes the need to widen the network, transfer scientific and soft-skill knowledge and know-how between the TWIN-PEAKS project partners, as well as involving the high-level professionals from outside the project, and tackle gender equality issues etc. Summer schools are one of a list of the good platforms for doing so.

2 Task 4.2 - Summer schools

Task 4.2 aims at targeting PhD students and early-stage researchers to take participation in summer schools. The task has planned to be started in M10 and ended in M30.

The first summer school was organized and hosted by VMU in July 19-23, 2021 (M10), and the second one took place at LEI in May 22-24, 2023 (M30). The first summer school focused on the following topic:

- Topic of the 1st summer school: @VMU – High-quality research preparation and results dissemination
- Topic of the 2nd summer school: @LEI – Advanced Gasification Solutions

The 2nd summer school was announced and promoted in advance via various social media and web channels:

- CYSENI – International conference on Energy and Natural Sciences issues
- TWIN-PEAKS Summer School on Advanced Gasification Solutions, 22-25 May 2023, Lithuania - TWIN PEAKS (twinpeaks-h2020.eu)
- TwinPeaksH2020 | Grupės | Facebook
- TWIN-PEAKS (@TwinPeaksH2020) / Twitter
- Tarptautinė vasaros mokykla "Advanced Gasification Solutions" vyks LEI - VDU Gamtos mokslų fakultetas

Official invitation to the 2nd summer school on Advanced Gasification Solutions is shown in Figure 1. To make the summer school more attractive 3 ECTS credits were promised to give the attendees. 2 ECTS credits participating at the summer school with practical exercises and 1 extra ECTS credit for the ones who also presented at the Twin-Peaks section in the International Conference on Energy and Natural Sciences Issues (CYSENI-2023) on 25 May, 2023.

TwinPeaks

International Summer School on Advanced Gasification Solutions

Subjects covered:

- Traditional gasification technologies.
- Plasma gasification technologies.
- Practical lab works, individual assignment to get ECTS credits, excursion.
- **Exclusive bonus:** opportunity to participate in the international conference CYSENI 2023.

  Selected papers will be published in MDPI journals: Applied Sciences, Plants.

Target group:

PhD and Master students.

Course aim:

Within the TwinPeaks summer school, you can gain more knowledge and practical experience in advanced gasification technologies. Also, meet new friends, have fun in the multicultural environment, and learn about Lithuanian culture.

Participants number is limited.

When
22-24 May 2023
Where
LEI, Lithuania
Language
English
Credits
3 ECTS
Fee
Free of charge
Registration deadline
1 May 2023

Registration to the TwinPeaks summer school here:

Organizers:

www.twinpeaks-h2020.eu

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 836819.

Figure 1.1: Invitation to the 2nd summer school on Advanced Gasification Solutions

2.1 Summer school programme

The summer school on Advanced Gasification Solutions have included not only lectures (six lectures in total), but also two practical exercises and study tour to Kaunas Waste Incineration Plant. Lectures were given by lectures from Technical University of Munich (TUM), Chalmers University of Technology (CTH) and Lithuanian Energy Institute (LEI). The agenda of the summer school is shown below:

22 May, 2023	
08:30 – 09:00	Registration
09:00 – 09:15	Welcome and agenda presentation
09:15 – 10:45	1st lecture: *“Entrained flow gasification for biomass and waste processing”*, PhD Sebastian Bastek, Technical University of Munich (TUM) – Online presentation
10:45 – 11:00	Coffee brake
11:00 – 12:15	2nd lecture: “*Thermochemical recycling of polymer rich waste*”, PhD Chahat Mandviwala, Chalmers University of Technology (CTH)
12:15 – 13:15	Lunch
13:15 – 14:45	3rd lecture: “*Gasification in stationary bed: from laboratory test to practical application*”, Dr. Nerijus Striūgas, Lithuanian Energy Institute (LEI)
14:45 – 15:00	Coffee brake
15:00 – 16:15	4th lecture: “*Renewable transport fuel production opportunities combined with cogeneration plant operation*”, Dr. Raminta Skvorčinskienė, Lithuanian Energy Institute (LEI)
23 May, 2023	
09:00 – 10:15	5th lecture: “*Plasma physics and application for energy recovery*” Dr. Liutauras Marcinauskas, Lithuanian Energy Institute (LEI)
10:15 – 10:30	Coffee brake
10:30 – 12:00	6th lecture: “*Thermal arc plasma for various phase organic waste treatment: LEI experience*”, Dr. Andrius Tamošiūnas, Lithuanian Energy Institute (LEI)
12:00 – 13:00	Lunch

13:00 – 16:00	Study tour to Kaunas Waste Incineration Plant, Kauno kogeneracinė jėgainė (kkj.lt)
18:00 – 22:00	Dinner at “Bernelių užeiga“, Address: M. Valančiaus g. 9, https://berneliuuzeiga.lt/
24 May, 2023	
09:00 – 12:00	Lab visits
12:00 – 13:00	Lunch
13:00 – 16:00	Practices (two groups, two exercises)
16:00 – 16:30	Summary and closing
18:00 – 21:00	Dinner together with CYSENI conference
25 May, 2023	
All day	Participation at the CYSENI conference, CYSENI – International conference on Energy and Natural Sciences issues

A study tour to Kaunas Waste Incineration Plant was organized on 23 May. Process engineer, Marius Sadeckas, introduced the activities of the plant and the participants of the summer school were guided around the plant’s site.

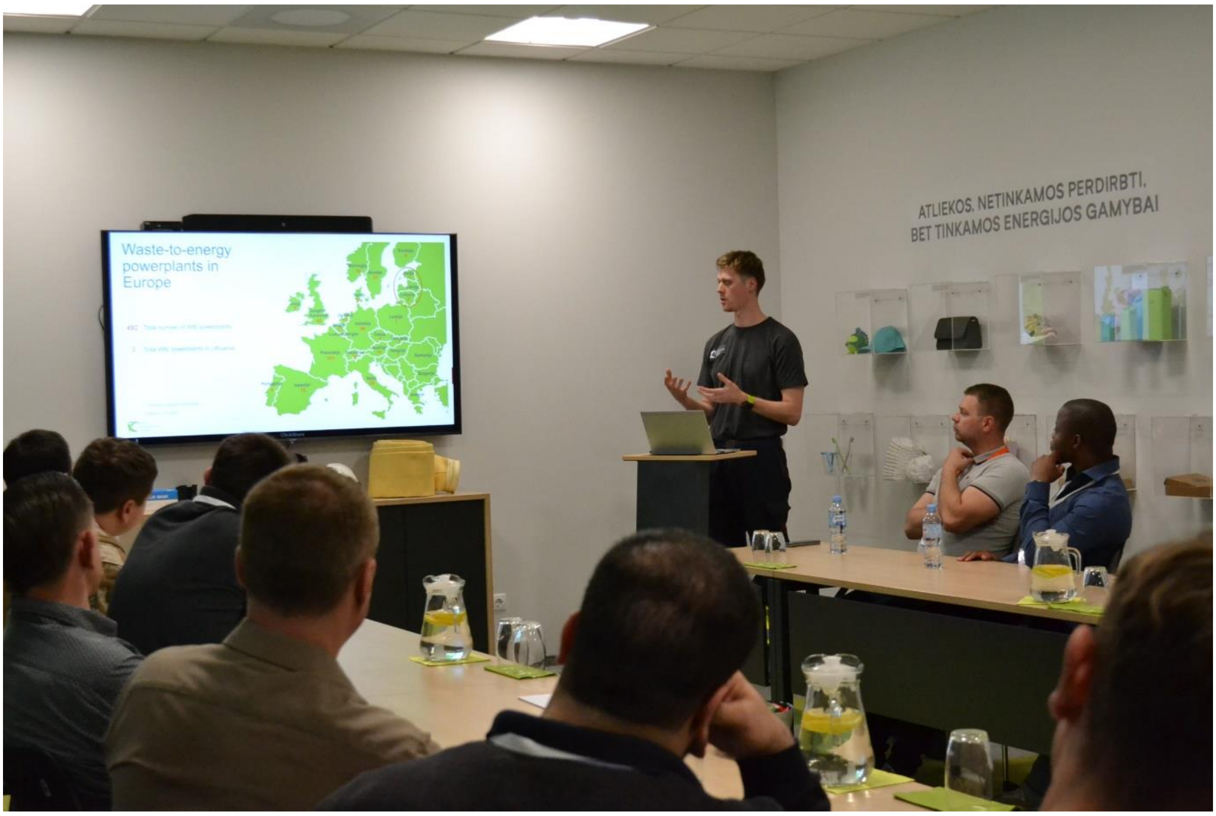


Figure 1.2: Participants of the 2nd Twin-Peaks summer school at LEI (May 2023)

After the summer school, on 25 May, a special section on ‘Bioenergy, Biomass and Biofuels’ dedicated to the TWIN-PEAKS project was organized at the CYSENI-2023 conference. Some summer school attendees have given presentation at the conference.

Shortcuts to lectures’ ppt. slides are provided in the appendixes. Full material is not included due to a big size of presentations with animations and videos. Examples of practical exercises and pictures of labs visits are also added to the Appendices.

2.2 Summer school participants

According to the project’s KPIs set on the number of attendees, each summer school should host up to 24 participants. The 1st summer school attracted 51 PhD students, whereas the 2nd a bit less. However, in total both international summer schools hosted 70 participants, which is more than enough to reach the KPI of total 48 attendees set in the proposal.

Thirty participants from all around the world (Europe, Africa, and Asia) have registered and nineteen out of thirty have participated at the 2nd summer school in Kaunas. The biggest delegation was from Lithuania (9), Germany (7 participants), Sweden (3 participants). All attendees were PhD students of different courses representing various institutions: Technical University of Munich (Germany), TU Bergakademie Freiberg (Germany), Chalmers University of Technology (Sweden), Kaunas University of Technology (Lithuania), Vytautas Magnus University (Lithuania), Lithuanian Research Centre for Agriculture and Forestry (Lithuania), Lithuanian Energy Institute (Lithuania). The picture of summer school participants is shown in Figure 1.3. List of participants is added in Appendixes of this report.

Figure 1.3: Participants of the 2nd Twin-Peaks summer school at LEI (May 2023)

Regarding the gender balance, the 2nd summer school was rather imbalanced with only two participants being women. This is mostly attributed to the specifics of the topic of the summer school, as in general a relatively small number of women are studying engineering, especially thermal and mechanical engineering.

For comparison, the gender balance of the 1st summer school as well as other TWIN-PEAKS events was very positive (Figure 1.4). This is mostly attributed to the profile nature of the project partner Vytautas Magnus University (VMU) covering social sciences, i.e. management and business.

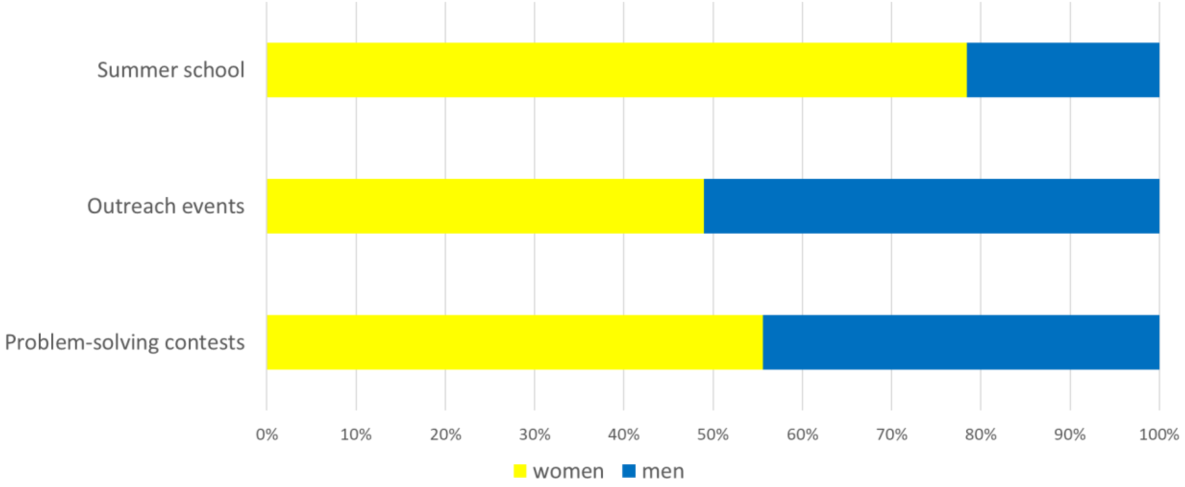
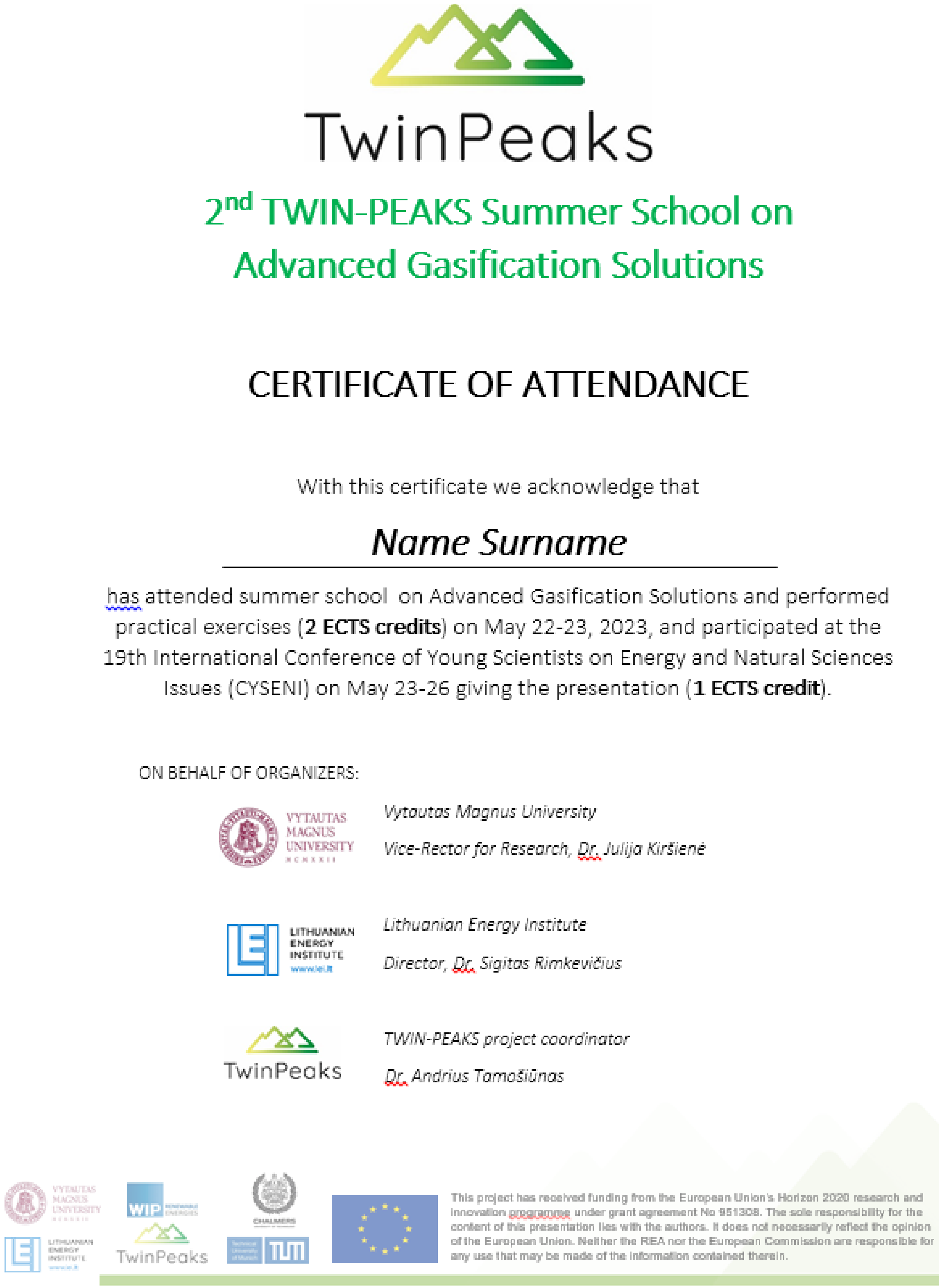


Figure 1.4: The gender spread among activities (1st summer school, outreach and problem-solving contest organized by VMU)

The summer school ended on 24 May and all participants have received certificates of attendance with ECTS credits provided. An example of the certificate is provided below in Figure 1.5.



TwinPeaks

2nd TWIN-PEAKS Summer School on Advanced Gasification Solutions

CERTIFICATE OF ATTENDANCE

With this certificate we acknowledge that

Name Surname

has attended summer school on Advanced Gasification Solutions and performed practical exercises (**2 ECTS credits**) on May 22-23, 2023, and participated at the 19th International Conference of Young Scientists on Energy and Natural Sciences Issues (CYSENI) on May 23-26 giving the presentation (**1 ECTS credit**).

ON BEHALF OF ORGANIZERS:

Vytautas Magnus University

Vice-Rector for Research, Dr. Julija Kiršienė

Lithuanian Energy Institute

Director, Dr. Sigitas Rimkevičius

TWIN-PEAKS project coordinator

Dr. Andrius Tamošiūnas

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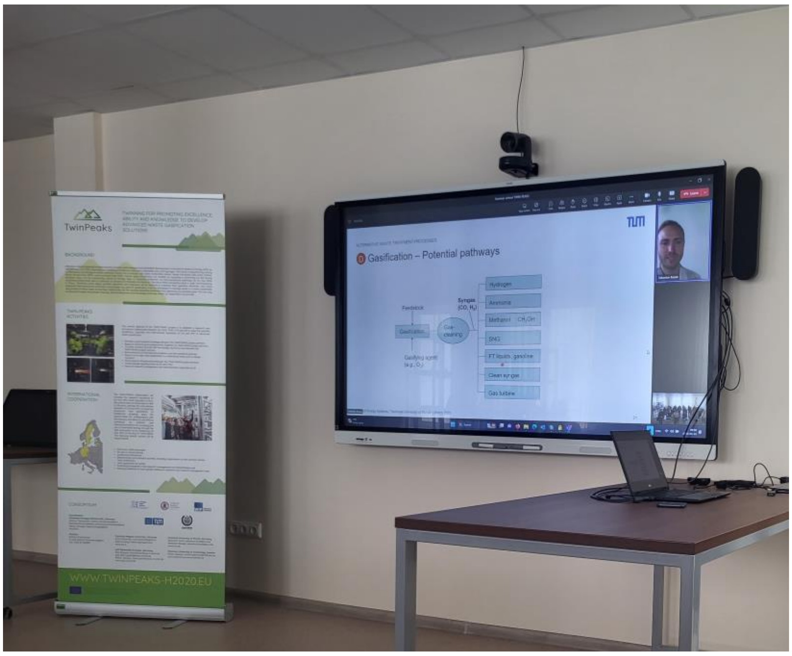
Figure 1.5: Certificate of attendance of the 2nd Twin-Peaks summer school

Summer school activities were accompanied by informal social networking that was also supported by the TWIN-PEAKS project.

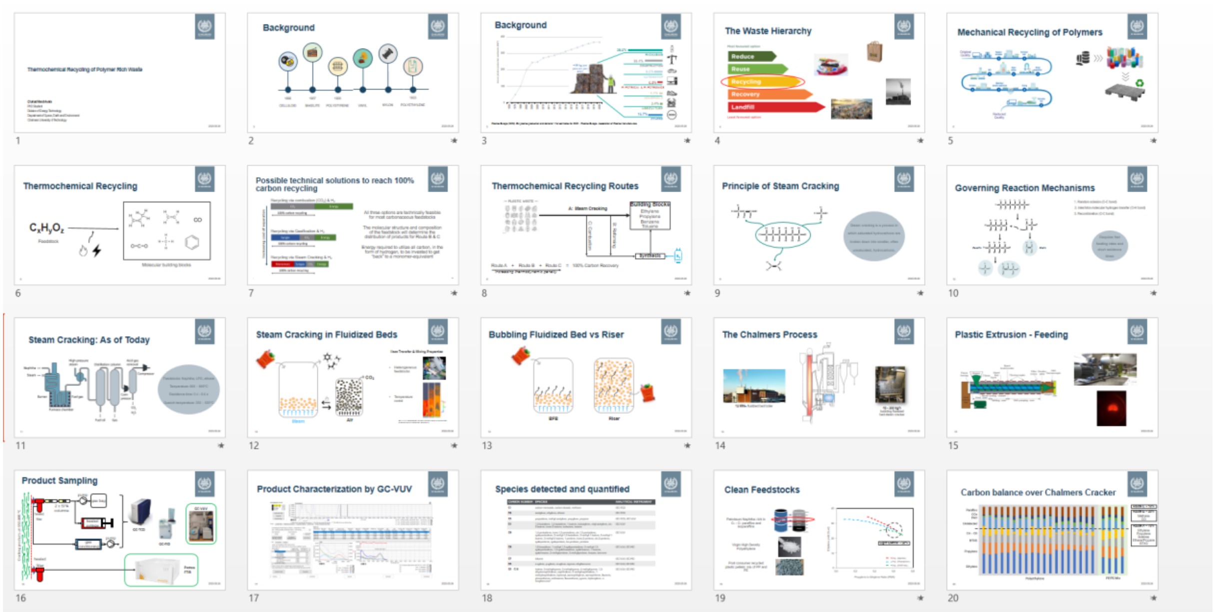
Appendixes

A Presentations of the 2nd summer school at LEI

Presentation by Sebastian Bastek (TUM):



Presentation by Chahat Mandviwala (CTH):



1 Thermochemical Recycling of Polymer Rich Waste

2 Background

3 Background

4 The Waste Hierarchy

5 Mechanical Recycling of Polymers

6 Thermochemical Recycling

7 Possible technical solutions to reach 100% carbon recycling

8 Thermochemical Recycling Routes

9 Principle of Steam Cracking

10 Governing Reaction Mechanisms

11 Steam Cracking: As of Today

12 Steam Cracking in Fluidized Beds

13 Bubbling Fluidized Bed vs Riser

14 The Chalmers Process

15 Plastic Extrusion - Feeding

16 Product Sampling

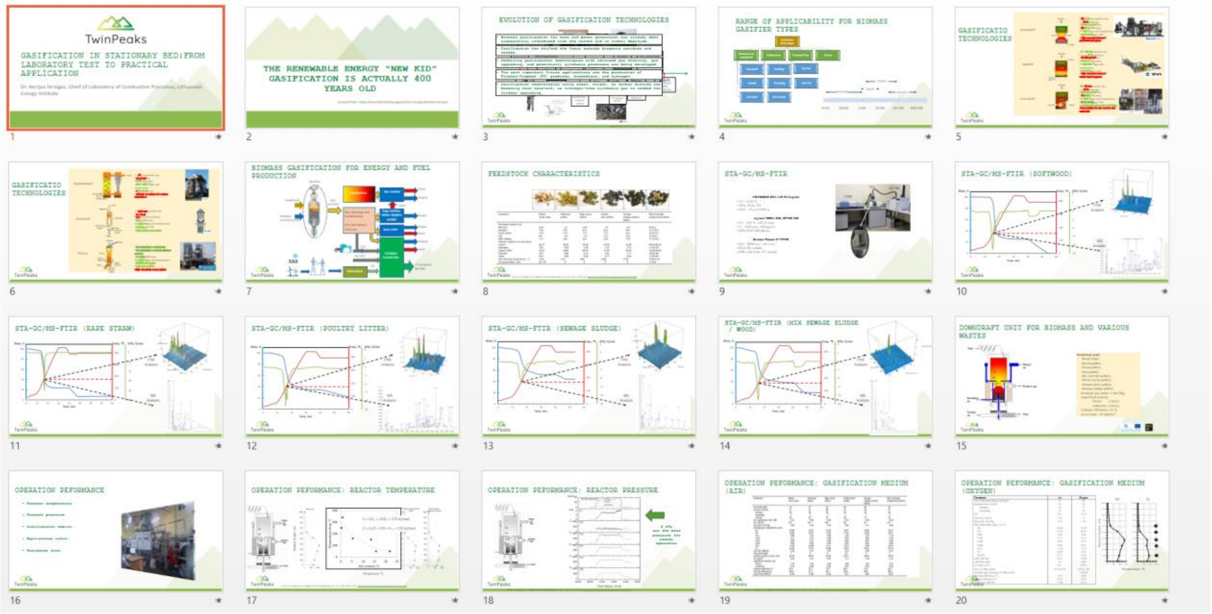
17 Product Characterization by GC-VUV

18 Species detected and quantified

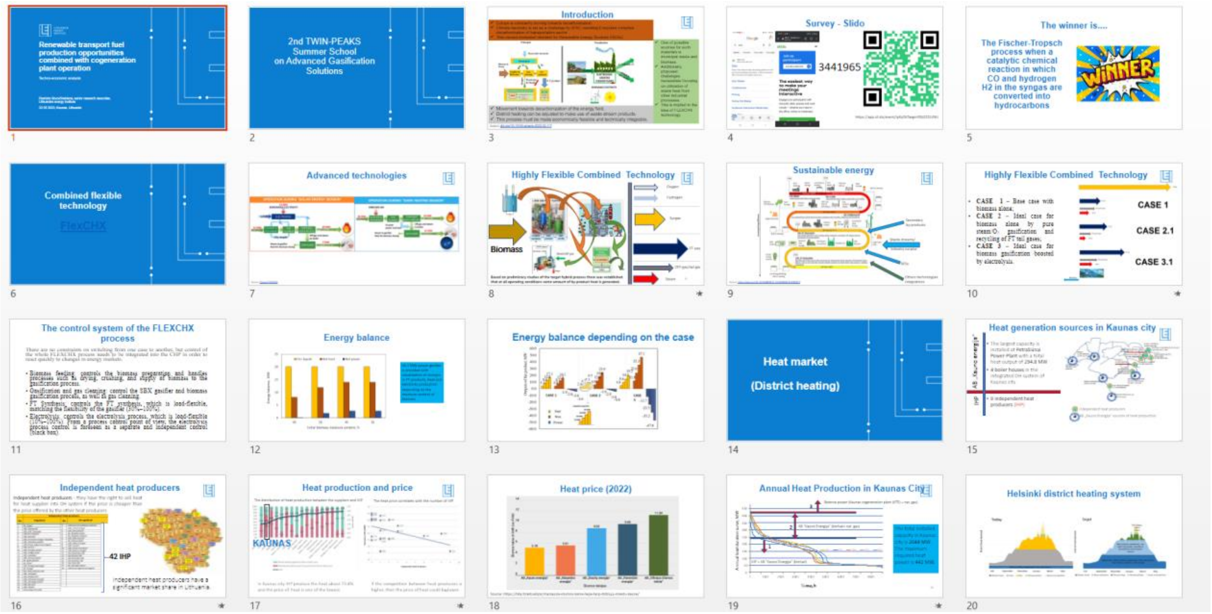
19 Clean Feedstocks

20 Carbon balance over Chalmers Cracker

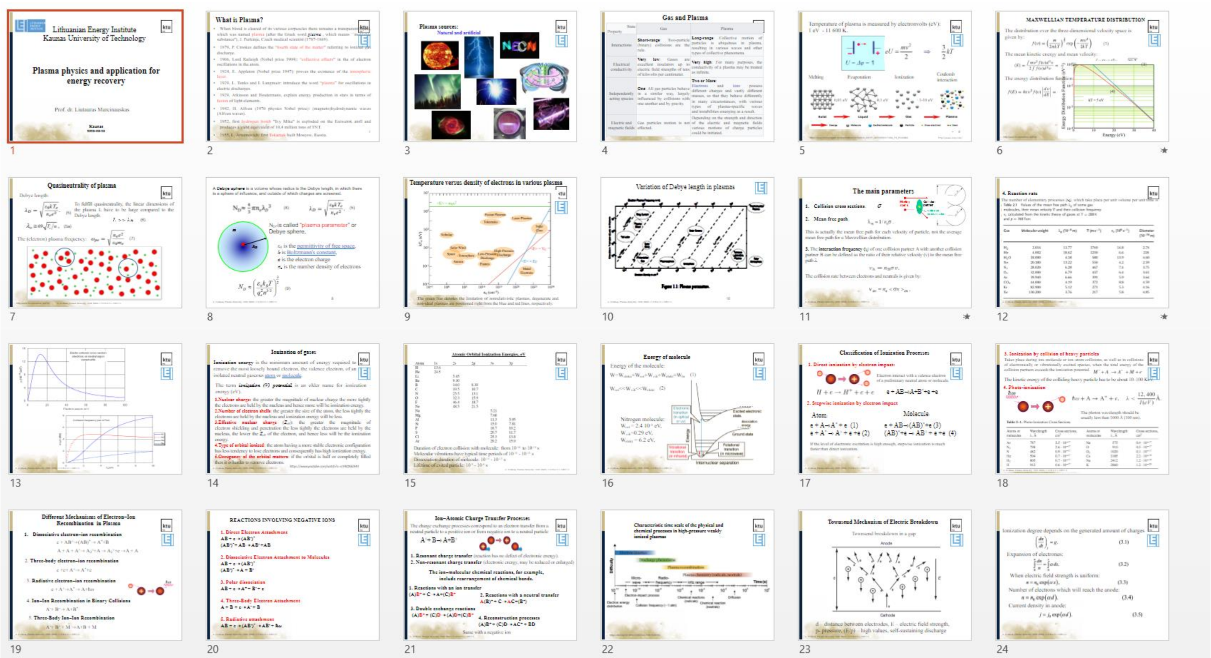
Presentation by Nerijus Striūgas (LEI):



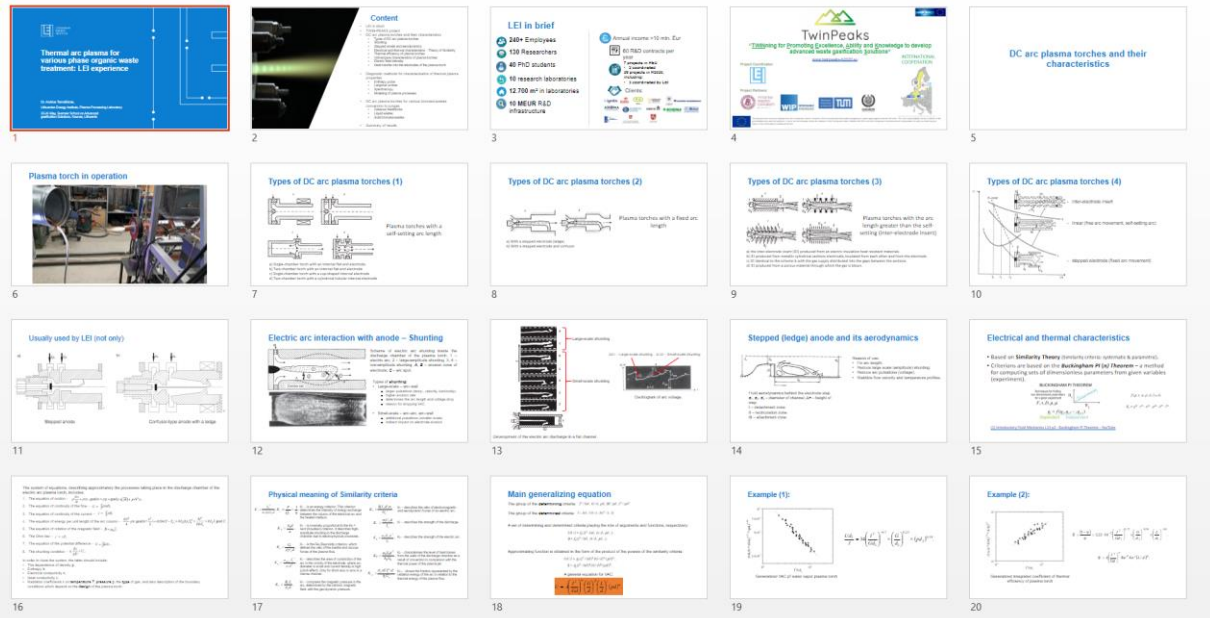
Presentation by Raminta Skvorčinskienė (LEI):



Presentation by Liutauras Marcinauskas (LEI):



Presentation by Andrius Tamošiūnas (LEI):



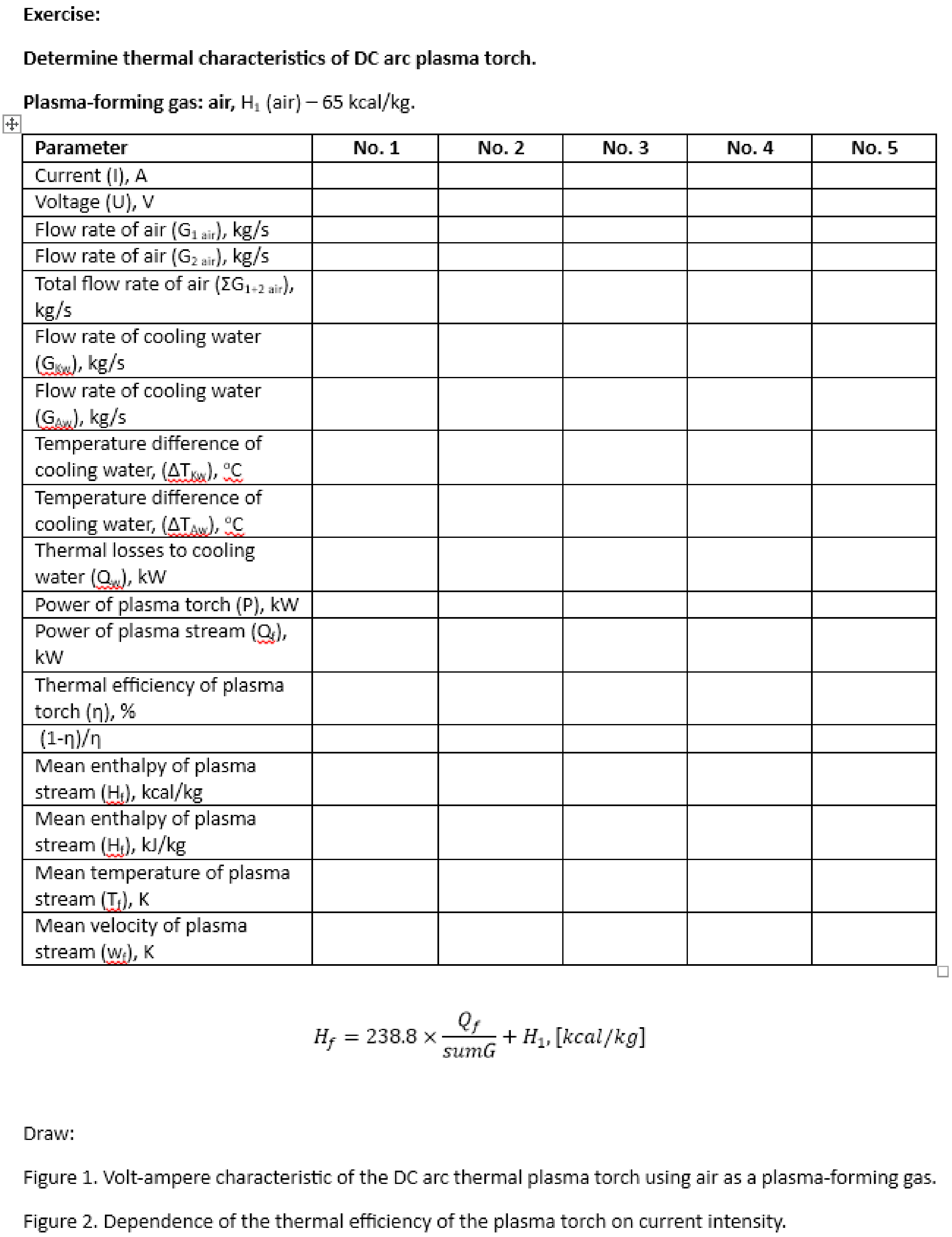
B List of participants at the 2nd summer school

2nd TWIN-PEAKS Summer School on Advanced Gasification Solutions
May 22-23, 2023
List of participants

	Name	Surname	E-mail	Institution	Signature
1	Justas	Eimontas	Justas.Eimontas@lei.lt	Lithuanian Energy Institute	
2	MatÃas Matías	Fierro	matias.fierro@tum.de	TUM	
3	Vishnu Prakash	Karunakaran	vishnuprakash245@gmail.com	DS Smith Lithuania	
4	Bauer	Johannes Fabian	johannesfabianbauer@gmail.com	Technical University Bergakademie Freiberg	
5	Ieva	Kiminaitė	ieva.kiminaite@lei.lt	LEI	
6	Dato	Jogiashvili	dato.jogiashvili.phd@gmail.com	Georgian Technical University	-
7	Dirk	Baganz	dirk.baganz@tbt.tu-freiberg.de	TU Bergakademie Freiberg/Institute for Drilling and Fluid Mining	
8	Brandstetter	Jonas	jonas.brandstetter@tum.de	Chair of Energy Systems at the Technical University of Munich	
9	Chahat	Mandviwala	chahat@chalmers.se	Chalmers University of Technology	
10	Ivan	Gogolev	gogolev@chalmers.se	Chalmers University of Technology	
11	Ibrahim	Rahmouni	ibrahim.rahmouni@univ-batna.dz	Rostock University	
12	Kęstutis	Žiūra	kestutis.ziura@vdu.lt	VMU Agriculture academy	
13	Rolandas	Uscila	rolandas.uscila@lei.lt	Lithuanian Energy Institute	
14	Mindaugas	Aikas	mindaugas.aikas@lei.lt	Lithuanian Energy Institute	
15	Hassan	Zhairabany	hassan.zhairabany@ktu.edu	Kaunas University of Technology	HASSAN
16	Eyberg	Vincent	vincent.eyberg@yahoo.com	Technical University Munich	
17	CÃ¡tia	Siueia	catiasiueia@gmail.com	Universidade Eduardo Mondlane	-
18	Stela Fernando	Miambo	miambostelafernando@gmail.com	Eduardo Mondlane University	-
19	Atif	Imdad	uo256361@uniovi.es	University of Oviedo	
20	Ameer Hamza	Jamil	ameer.hamza.jamil786@gmail.com	University of Engineering and Technology Lahore	
21	Hassan	Zhairabany	hassan.zhairabany@ktu.edu	Kaunas University of Technology	
22	Shervin	Hadian	shervin.hadian@lammc.lt	Lithuanian agriculture and forest science institute	-
23	Befkadu Mewded	Habtamu	mewded2013@gmail.com	Ethiopian Biodiversity Institute	
24	Cruz	Marrune	cruz.marrune@dbi-gruppe.de	TU Bergakademie Freiberg	
25	Mohab	Salem	Mohab.salem@lei.lt	Lithuanian Energy Institute	
26	Renesteban	Forero Franco	rforero@chalmers.se	Chalmers University of Technology	
27	Ieva	Gudžinskaitė	Ieva.Gudzinskaite@lammc.lt	Lietuvos agrarinių ir miškų mokslo centras	
28	MÃ¡rio Ernesto	Sitoe	Sitoem05@gmail.com	Universidade Eduardo Mondlane	-
29	Johannes	Wassmuth	johannes.wassmuth@tum.de	TUM	
30	Ernest	Bykov	Ernest.bykov@lei.lt	LEI	

C Examples of practical exercises

1. Practical exercise on determining thermal characteristics of DC arc plasma torch.



Exercise:

Determine thermal characteristics of DC arc plasma torch.

Plasma-forming gas: air, H_1 (air) – 65 kcal/kg.

Parameter	**No. 1**	**No. 2**	**No. 3**	**No. 4**	**No. 5**
Current (I), A					
Voltage (U), V					
Flow rate of air ($G_{1\ air}$), kg/s					
Flow rate of air ($G_{2\ air}$), kg/s					
Total flow rate of air ($\Sigma G_{1+2\ air}$), kg/s					
Flow rate of cooling water (G_{Kw}), kg/s					
Flow rate of cooling water (G_{Aw}), kg/s					
Temperature difference of cooling water, (ΔT_{Kw}), °C					
Temperature difference of cooling water, (ΔT_{Aw}), °C					
Thermal losses to cooling water (Q_w), kW					
Power of plasma torch (P), kW					
Power of plasma stream (Q_f), kW					
Thermal efficiency of plasma torch (η), %					
(1-η)/η					
Mean enthalpy of plasma stream (H_f), kcal/kg					
Mean enthalpy of plasma stream (H_f), kJ/kg					
Mean temperature of plasma stream (T_f), K					
Mean velocity of plasma stream (w_f), K					

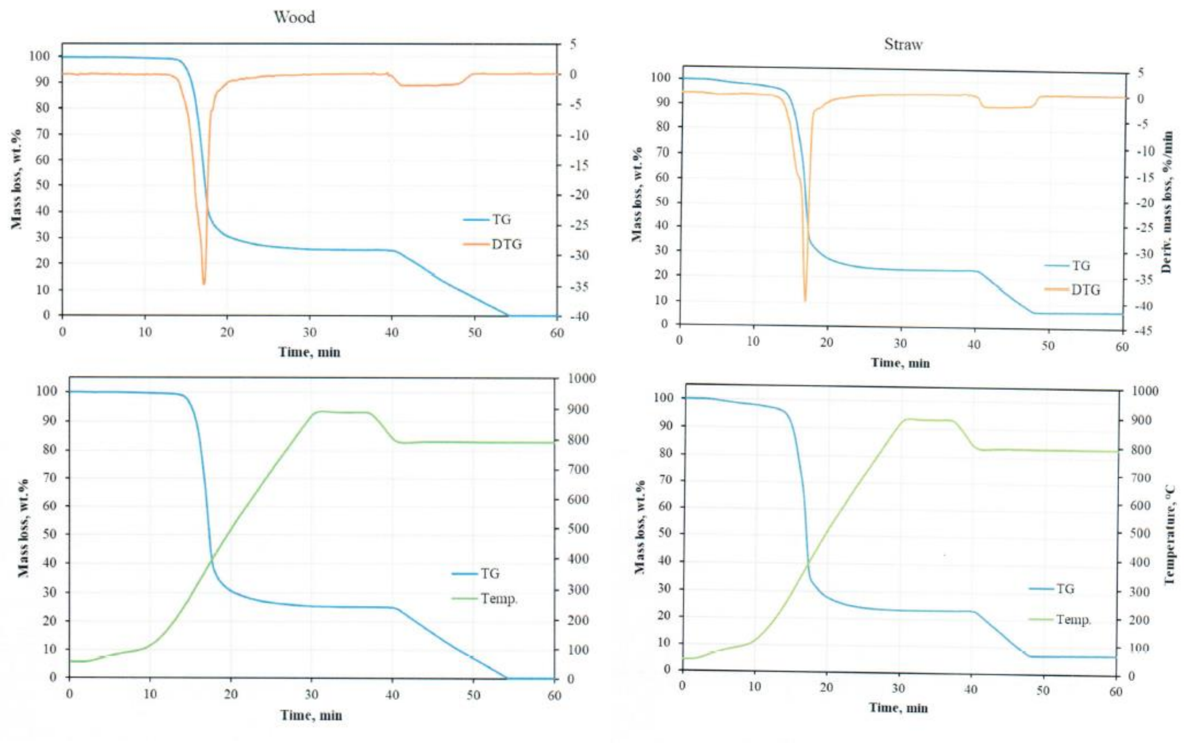
$$H_f = 238.8 \times \frac{Q_f}{sumG} + H_1, [kcal/kg]$$

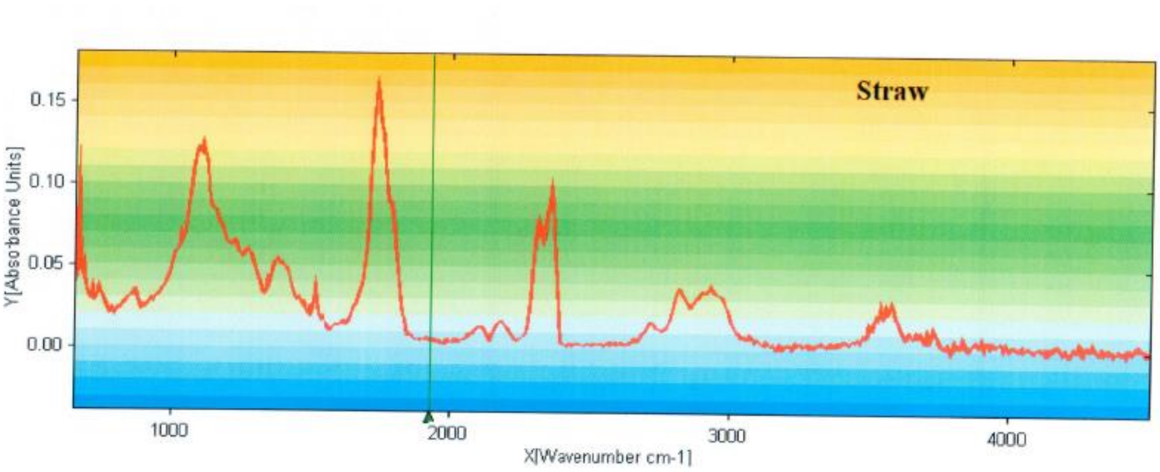
Draw:

Figure 1. Volt-ampere characteristic of the DC arc thermal plasma torch using air as a plasma-forming gas.

Figure 2. Dependence of the thermal efficiency of the plasma torch on current intensity.

2. Practical exercise on proximate analysis of different feedstocks (wood, straw, sunflower husks) by TG-FTIR and TG-GC/MS.





D Labs visit at LEI