المركز الوطني للأبحاث وتطوير الزراعة المستدامة
NATIONAL RESEARCH AND DEVELOPMENT CENTER FOR SUSTAINABLE AGRICULTURE

THE FIRST INTERNATIONAL FORUM AND EXHIBITION FOR SUSTAINABLE AGRICULTURE
#IFESA2023

KFU جامعة الملك فيصل KING FAISAL UNIVERSITY

Green Energy from Industrial-Agro Waste: A Promising Pathway Forward

Yousef Abdul Basit, Khalid Alrumayh, Reda AL-Helal, Waleed Alyousofi, Mostafa Azam, and Mohamed Ismail*
Dept. of Mechanical Engineering, King Faisal University, Saudi Arabia - Email: maismail@kfu.edu.sa

Introduction,

The rapid growth of industrial and agricultural sectors has led to an unprecedented increase in waste generation, posing significant environmental challenges. However, amidst these challenges lies an untapped opportunity – the immense energy potential of industrial-agro waste. This study aims to shed light on harnessing this potential for orange, mango, and lemon juice industry and exploring its viability as a renewable energy solution.

Objectives,

The project aims to collect industrial-agro waste from orange peel, mango peel, and lemon peel, followed by drying, grinding, and measuring the physio-chemical properties and particle size distribution. The ultimate objective is to calculate the kinetic parameters for burning these materials to produce energy.

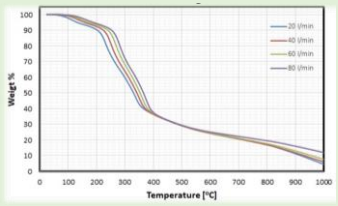
Materials & Methods

- **Sample Preparation Process**: Collecting, drying, and grinding.
- **Physio-chemical properties** : In this step the following tests are done; proximate and ultimate analyses, fiber analysis, heating value analysis, SEM and XRD analysis.
- **Sieve test**: To measure the particle size distribution for each sample.
- **TGA test**: To calculate the kinetics parameters as activation energy and pre-exponential factor.

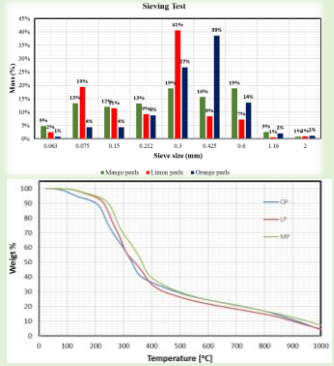
Results/ Diagrams/Tables

Average size (mm)

Mango peels	Limon peels	Orange peels
0.3407	0.2770	0.1594



Weight loss versus temperature for Orange Peels at various heating rates



Weight loss versus temperature for various samples at heating rate of 20 °C/min

Photograph

Conclusions

The ground powder obtained from fruit peels exhibits an average particle size of 0.15 mm, 0.27 mm, and 0.34 mm for orange, lemon, and mango, respectively. These particle sizes meet the requirements for pellet manufacturing, indicating their suitability for further processing. The TGA results reveal an average activation energy of 138.1 kJ/mol, which is lower compared to carbon samples. This characteristic makes the waste materials particularly attractive for utilization in power plants as a substitute for coal.

Recommendation/Acknowledgments

In order to investigate the combustion characteristics of these waste materials in a fixed-bed combustor, it is necessary to produce pellets of different sizes. This approach closely simulates the conditions found in furnaces utilized in coal power plants.

References

1. S. Marçal and M. Pintado, Trends in Food Science & Technology, (2021) Vol. 114.
2. https://www.theworldcounts.com/challenges/planet-earth/state-of-the-planet/world-waste-facts