



Aalborg Universitet

AALBORG UNIVERSITY
DENMARK

Hydrothermal liquefaction of high ash containing sewage sludge at sub and supercritical conditions

Shah, Ayaz Ali; Toor, Saqib; Conti, Federica; Rosendahl, Lasse

Publication date:
2019

Document Version
Publisher's PDF, also known as Version of record

[Link to publication from Aalborg University](#)

Citation for published version (APA):

Shah, A. A., Toor, S., Conti, F., & Rosendahl, L. (2019). *Hydrothermal liquefaction of high ash containing sewage sludge at sub and supercritical conditions*. Poster presented at 27th European Biomass Conference and Exhibition (EUBCE 2019), Lisbon, Portugal.

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- ? Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- ? You may not further distribute the material or use it for any profit-making activity or commercial gain
- ? You may freely distribute the URL identifying the publication in the public portal ?

Take down policy

If you believe that this document breaches copyright please contact us at vbn@aub.aau.dk providing details, and we will remove access to the work immediately and investigate your claim.

Hydrothermal liquefaction of high ash containing sewage sludge at sub and supercritical conditions

Ayaz A. Shah*, Saqib S. Toor*, Federica Conti*, and Lasse A. Rosendahl*

*Department of Energy Technology, Aalborg University, Pontoppidanstræde 111, Aalborg, 9220, Denmark.

Abstract

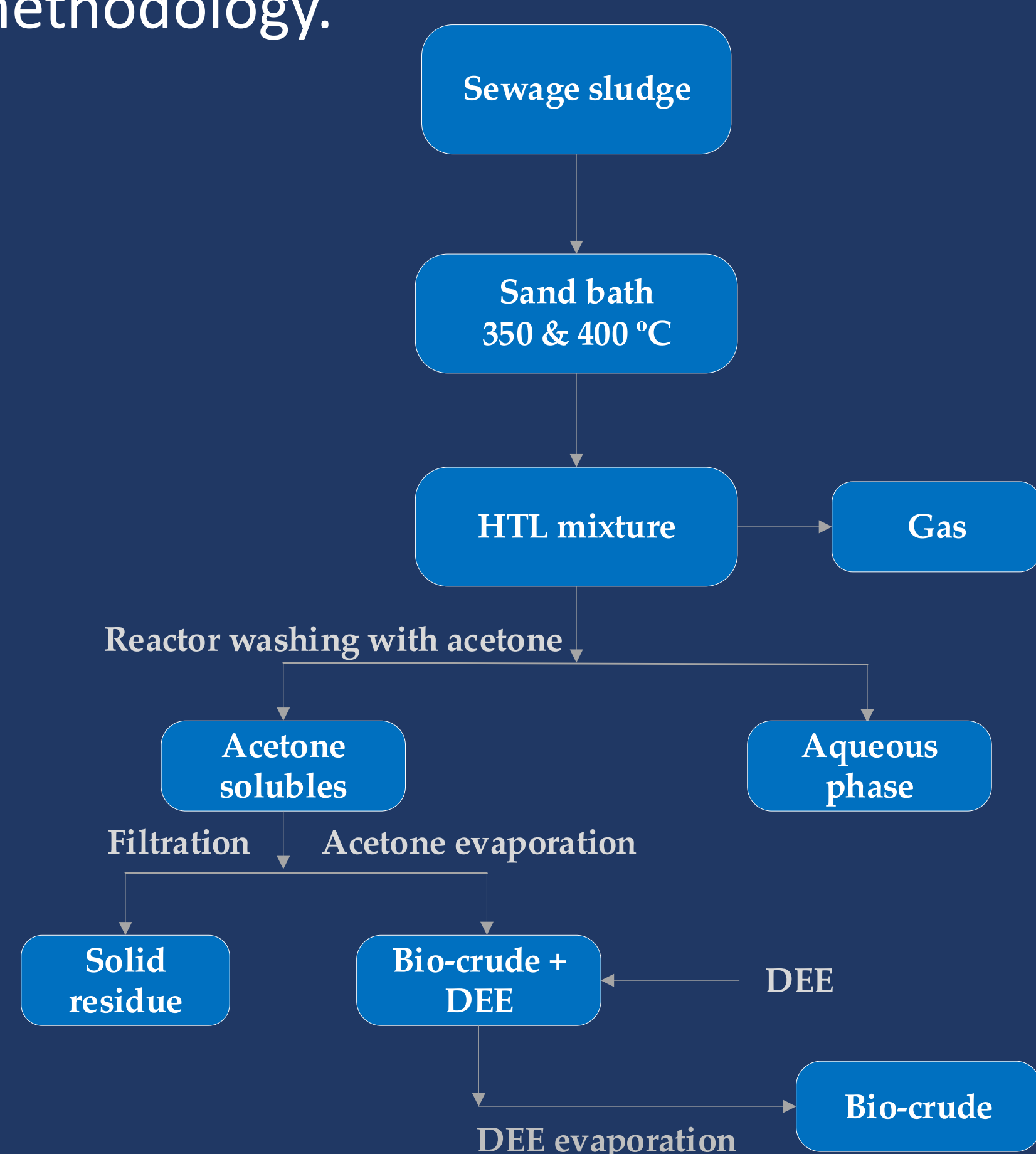
With the rapid growth in population and urbanization, sustainable disposal of sewage sludge has become a prominent problem worldwide. Therefore, an adequate treatment is required to reduce the environmental impacts created from traditional methods such as incineration, landfill, etc. In this context, sewage sludge has been liquefied hydrothermally under sub-supercritical conditions, with and without catalyst (K_2CO_3) in micro-batch reactors.

Objectives

- To convert sewage sludge into the high quality bio-crude.
- To investigate the effect of temperature and catalyst on product distribution at sub and supercritical conditions.

Methodology

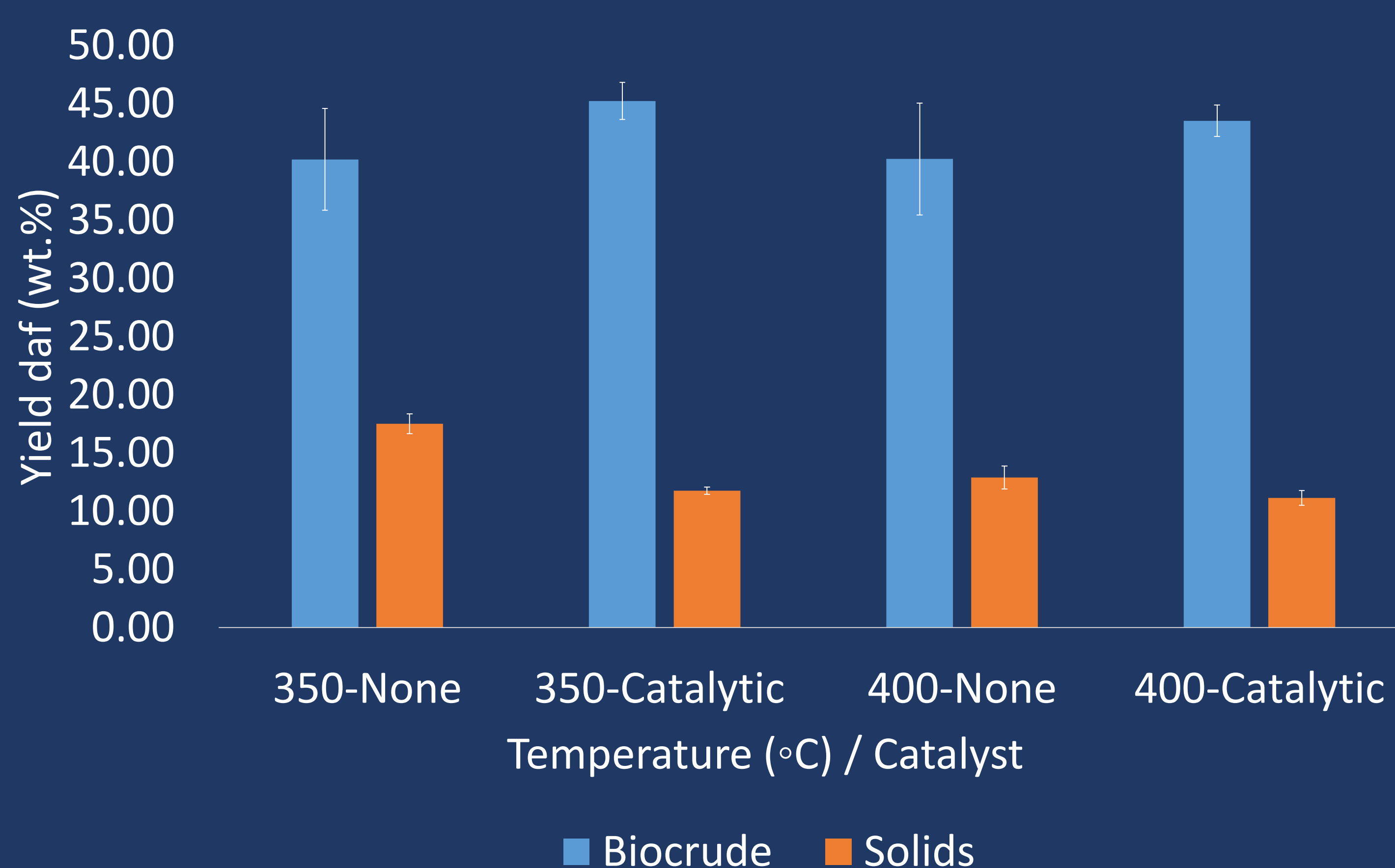
A secondary Sewage sludge sample was collected from Aalborg East Wastewater Treatment Plant, Forsyning (Renseanlaeg Ost), Aalborg East, Denmark. Later on, the liquifaction experiments were performed at sub & supercritical conditions by adopting the following methodology.



Proximate and ultimate analysis of sewage sludge (daf wt.%)				
Moisture	Ash	Protein	Fat	Carbohydrate
73.39	40.63	43.16	7.79	48.16
C	H	N	O	HHV (MJ/kg)
50.95	7.36	6.91	34.78	22.15

Results

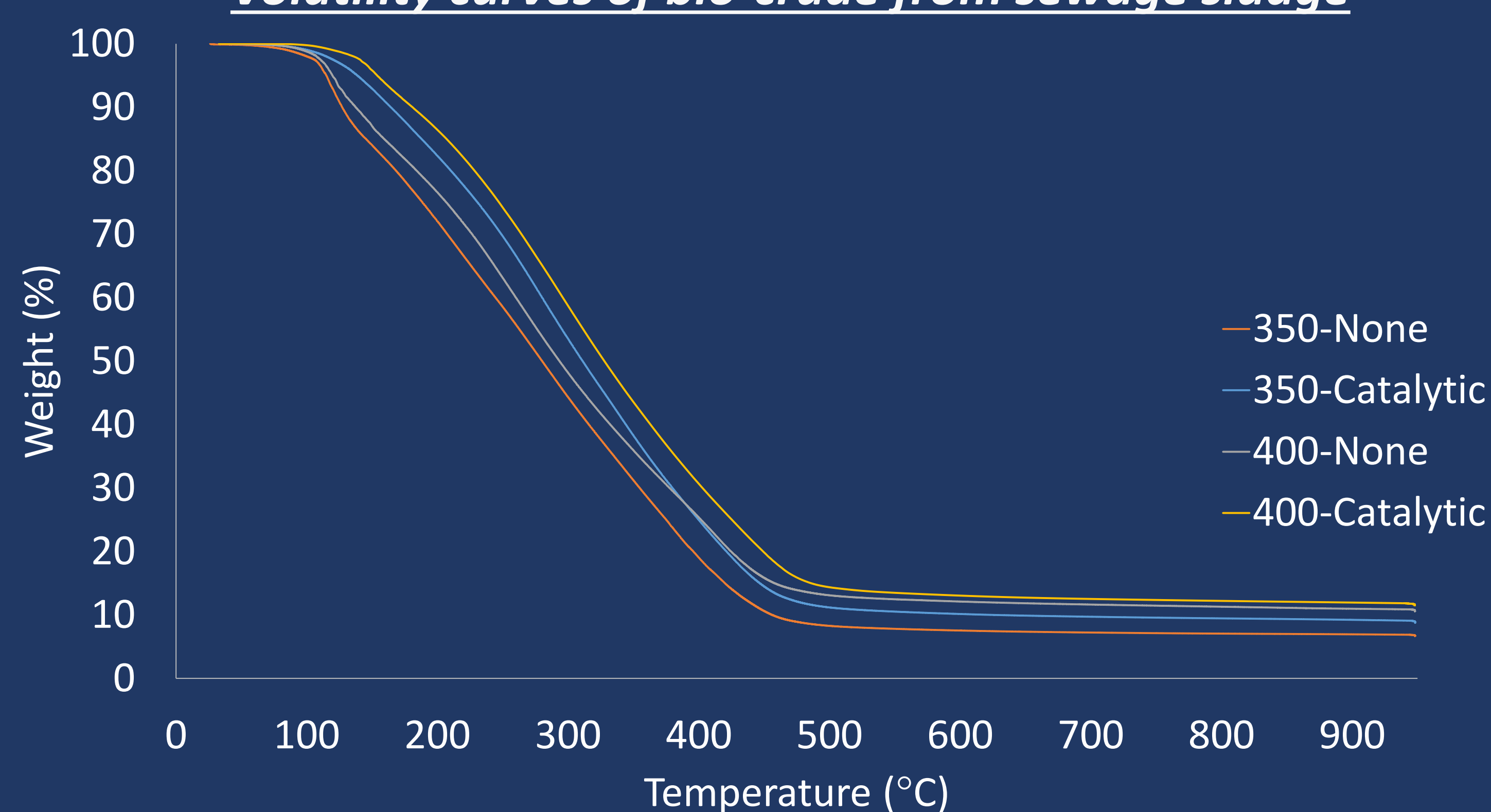
Bio-crude yields at sub and supercritical conditions



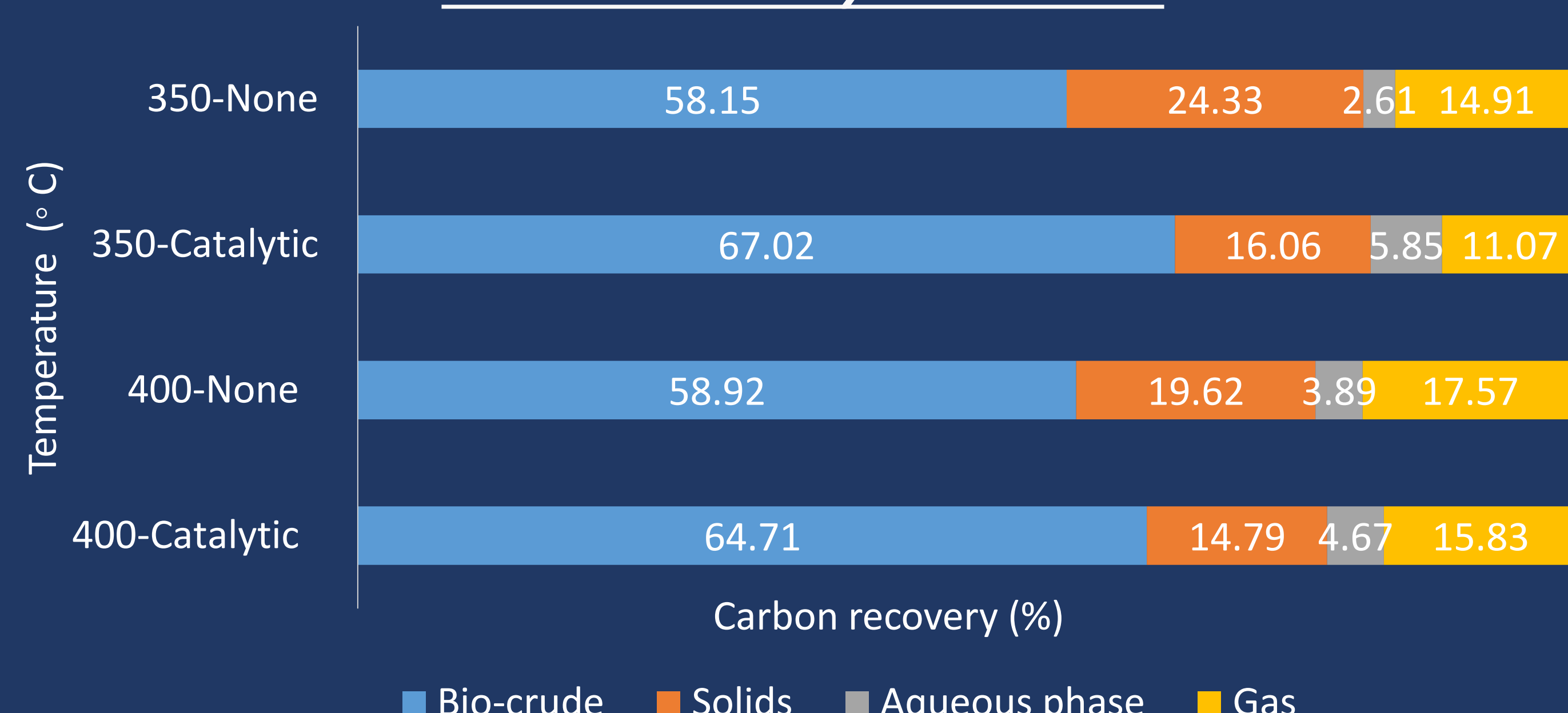
Bio-crude Quality from sewage sludge

Samples	C (%)	H (%)	N (%)	O (%)	HHV (MJ/kg)	ER (%)
Sew. sludge	30.25	4.37	4.10	20.67	13.17	----
350-None	73.68	10.09	5.71	10.52	35.30	63.98
350-Catalytic	75.51	10.56	4.69	9.24	36.60	74.60
400-None	74.60	10.33	5.20	9.88	35.95	65.21
400-Catalytic	75.75	10.22	3.77	10.26	36.21	71.04

Volatility curves of bio-crude from sewage sludge



Carbon recovery in Products



Conclusion

- The temperature had a negligible influence on bio-crude yield and quality, whereas catalyst (K_2CO_3) slightly improved both the yield and quality.
- The overall, 58-67% of the carbon went into the bio-crude at both sub and supercritical conditions.
- The bio-crude at supercritical conditions contained lower nitrogen, which indicates that higher temperature is favorable for lower N-content in bio-crude.
- The supercritical aqueous phase contained high TOCs as compared to subcritical. The overall TOCs of the aqueous phases in the range of 23 to 49 g/l, which could be used as a recirculation solvent.
- Based on these batch scale experiments, it is challenging to choose an optimal condition for the production of bio-crude from sewage sludge, because, in continuous HTL processing, a lot of other aspects need to be considered.

Acknowledgements

This research work was funded by the Higher Education Commission (HEC), Government of Pakistan.

