Wet biomass: Municipal Solid Waste

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Source: https://www.worldbank.org/en/news/immersive-story/2018/09/20/what-a-waste-an-updated-look-into-the-future-of-solid-waste-management

Wet organic waste valorization options



Waste to fuel process: hydrothermal liquefaction (HTL)





C. Perego and M. Ricci, Catal. Sci. Technol., 2012, 2, 1776–1786

HTL technology development status

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- Several companies have been developing HTL processes up to the near-commercial scale (D. Castello et al., Energies 2018, 11, 3165).
- Eni has operated a demo plant at Green Refinery of Gela to treat the organic fraction of the MSW to produce bio-oil since 2018. The development up to the industrial scale will be pursued through public-private partnerships, exploring different scenario (large scale plants up to 150 kton/y of waste; low scale plants for small communities).

https://www.eni.com/enirewind/en_IT/circular-economy/waste-to-fuel.page

SYDNEY, Sept. 14, 2021 -- Licella Holdings Ltd is announced the successful commissioning of its upgraded <u>Cat-HTR™</u> commercial-demonstration plant. The facility represents a universal HTL platform that can process the widest range of post-consumer biomass residues and plastics in the world. The new facility will be capable of producing up to 140 barrels of sustainable oil per day (around 21 ton/d) a direct substitute for fossil crude.



https://www.newswire.com/news/global-technology-pioneers-licella-announce-commissioningof-worlds-21498739

Summary

- Introduction Waste: problem or opportunity
- Waste management and circular economy
- Zero Emission target and biofuel scenario
- Conventional vs advanced biofuel
- Circular economy: waste biomass to advanced biofuel
 - Fermentation vs Thermochemical process
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- Conclusion



Municipal Solid Waste: plastic fraction

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Source: https://www.worldbank.org/en/news/immersivestory/2018/09/20/what-a-waste-an-updated-look-into-the-future-ofsolid-waste-management

- 240 Mt/yr of Plastic Waste are potentially available for recycling and, if this is not possible, for the production of biofuels
- Plastic waste collection in Europe (2019)was 27.1 Mt



Source: https://journals.openedition.org/factsreports/5102

Plastic waste in Italy: recycle and energy recovery

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Source: ISPRA 2019

Plastic recycle in Italy

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Plastic Packaging 2018 (Kton)



Source: Corepla-relazione Gestionale 2018

Plasmix to Recycled Carbon Fuels?



Pyrolysis: characteristics of plastics and oil products

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Crude oil: mixture of hydrocarbons, which processed in an oil refinery to obtain e.g.

- <u>Gasoline</u> : chain length of between 6 and 9 carbon atoms.
- <u>Diesel</u> : chain length of between 10 and 18 carbon atoms.

Plastic: wide range of polymers produced using highly refined fractions of crude oil, or chemicals derived from crude oil (monomers).

Some polymers also contain <u>oxygen</u> (e.g. polyethylene terephthalate (PET)), whereas others contain <u>chlorine</u> (polyvinyl chloride (PVC)).

To convert plastic into hydrocarbon fuels :

- 1. The long polymer chains need to be broken down to produce compounds with shorter chains.
- 2. Any non-hydrocarbon atoms present (e.g. oxygen, chlorine) **need to be removed.**



Atomic Composition of fuels and Plastics

Waste to fuel process: gasification



Capacity: 24 kt/y bio-EtOH

Nextchem and Circular economy

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- NextChem is Maire Tecnimont's subsidiary operating in the field of circular economy.
- "Circular Economy" is focused on the recycling of plastic waste to produce renewable fuel, hydrogen or other valuable chemicals.
- The technology is based on the gasification of Plasmix and/or RDF to produce syn gas, followed by the transformation to the desired final product.
- July 2020: NextChem and Lanzatech signed an agreement to promote circular ethanol production.
- September 2022: Maire Tecnimont, 194 M€ for Rome Hydrogen Valley. 200 Kt/y of RDF to 1.5 Kt of H₂ and 55 Kt of ethanol.



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Conclusions

- ✓ Reduce the mobility GHG emission (21% of the overall) by renewable fuel
- Promote advanced biofuels from non-food, raw material residual agroforestry biomass and urban waste
- Valorize the huge amount of residual agroforestry biomass and urban waste, i.e. transform wastes from problems into opportunity
- Improve management and sorting of waste according to circular economy
- Improve the technology routes to transform waste to fuels to make viable large-scale applications

Italy lacks resources but has an excellent agriculture and manufacturing industry. Consequently, rich of waste and residues. Industrial systems, research institutions and academia can play a significant role in this concern.

Russia's Invasion of Ukraine is helping warm the planet

(Wired, March 18, 2022)

Direct damage:

• The so-called carbon 'bootprint' of this war is counted in millions of tonnes and undermines efforts towards CO2 emissions reduction.

Indirect environmental impacts:

- UN secretary António Guterres urges all nations to "to put the pedal to the metal towards a renewable energy future."
- Others are sceptical and almost sure that this war will disrupt all efforts towards Paris agreement goals. CO₂ emissions will increase of some governments decide to replace Russian fossil fuels with import from other countries and fill the gap with coal energy. Building new supply chains, new logistics and infrastructure in attempt to replace Russian hydrocarbons will almost surely lock the world into irreversible warming.



Thank you!



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