Waste Accumulation Problems and Opportunities

Zoltan Kish, *Ph.D.*
Quasar ScienceTech
Burlington, Ontario, Canada
Email: kishz@quasarsciencetech.com

September 2018

An incredible amount of waste is produced in Canada and around the world. We are killing our planet by dumping 2.12 billion tons of garbage every year and polluting the oceans, land, and air [1]. Consequently, we need sustainable and effective waste management to protect our environment and save our world. It is particularly important now after China banned foreign waste acceptance, and more garbage ends up in landfills and water resources creating enormous environmental problems.

In 2016, the Ontario government released its Strategy for a Waste-Free Ontario [2], diverting our wasteful ways towards an entirely circular economy, but it doesn't seem to be widely discussed. This strategy requires appropriate tools and an innovative approach to solving the tremendous waste accumulation problem. Particularly, after China stopped the import of foreign waste, the waste recycling facilities around the world cannot send recycled waste to China anymore, and municipalities are facing pileups of garbage, substantial extra costs and the risk of losing millions in revenue. The following websites reflect this problem in Canada and globally:

- https://www.washingtonpost.com/news/energy-environment/wp/2018/06/20/a-giant-wave-of-plastic-garbage-could-flood-the-u-s-in-10-years-a-study-says/?noredirect=on&utm_term=.d8f30513a28f
- https://www.theglobeandmail.com/news/national/chinese-ban-on-foreign-recyclables-leaving-some-canadian-cities-in-the-lurch/article37536117/
- https://www.thespec.com/news-story/8048791-chinese-ban-dumps-on-city-s-recycling-parade/
- https://www.canadafibersltd.com/on-point-canada-fibers/#more-1812
- https://www.express.co.uk/news/uk/980704/eu-plastic-recycling-makes-pollution-worse
- https://www.politico.eu/article/europe-recycling-china-trash-ban-forces-europe-to-confront-its-waste-problem/

Under the new circumstance, some municipal governments could get out of the recycling business altogether, and the recycled waste will end up in the landfills while the energy in waste is mostly lost, creating mountains of trash, emitting harmful pollutants into our air, water, and soil. In landfills, the

biodegradable components of garbage decompose and emit greenhouse gases (e.g., methane, carbon dioxide, hydrogen sulfide, ammonia), which increase global warming. Also, the toxic content of the waste contributes to landfill leachate, which eventually leaks and contaminates nearby ecosystems.

Until January 2018, the world applied a short-sighted and self-serving strategy to deal with the waste: sending waste to China and other East Asian countries and dispose of waste into landfills and the oceans. As it was written in the Bloomberg article, "Without bold new ideas and management strategies, current recycling rates will no longer be met, and ambitious goals and timelines for future recycling growth will be insurmountable" [3].

We need more effective and sustainable ways to manage the produced waste. The government could address the demand to solve the incredible waste accumulation by developing appropriate tools for the waste management challenges. One man's trash can be another man's treasure. For example, depending on the waste plastic composition and level of contaminations, the plastic feedstock could be effectively converted into high-value products through pyrolysis and waste steam gasification technologies. If the plastic feedstock is clean and has an appropriate composition, pyrolysis can be applied to depolymerize plastic and convert it mostly into liquid fuel. The steam gasification reformation technology is more suitable for contaminated plastic waste conversion into high energy value syngas and hydrogen. Additionally, syngas can be converted into liquid fuels and green chemicals using Gas-to Liquid catalytic process.

The advanced and effective Waste-to-Energy technology applications in combination with a reliable scrubbing/cleaning system can provide a solution for biodegradable and non-biodegradable waste disposal, clean energy production, and sustainable product regeneration. The waste, potentially, can be converted into various forms of clean energy products, such as electricity, hydrogen, liquid synthetic fuels, and "green" chemicals. Trash can be a cost-effective and environmentally sound supply of clean energy source and replace a portion of fossil fuels. High quality liquid synthetic fuels without sulfur contamination can be produced from waste materials by a combination of a Waste-to-Gas technology with a Gas-to-Liquids technology based on the Fischer–Tropsch catalytic process. Perspectives on different Waste-to-Energy technologies have been presented in the following articles [4, 5, 6].

Regrettably, incineration has been often considered as a Waste-to-Energy technology to process waste for an astonishing price and producing relatively low power. For example, a new incinerator has been built for a very high price - £1.4 billion in York and North Yorkshire in the UK. The incinerator will divert more than 230,000 tonnes of household waste but will produce only 24 MW of power [7].

Another example of an enormous and overpriced incineration facility is being built in Hong Kong. The project will cost $4 billion by processing 3000 tonnes/day (1,050,000 tonnes/year) and produce just 489 million kWh/year of energy, which is equivalent to 57 MW of power [8]. Incineration is a very costly and inefficient way for waste conversion into electricity and generating highly toxic and carcinogenic pollutants.

In a circular economy advanced emerging waste conversion technologies (e.g., Waste-to-Energy, Waste-to-Gas, and Gas-to-Liquids technologies) can play a pivotal role in waste disposal. Efficient waste conversion technology applications can be a path to a working circular economy. Recycling is not only based on simple reusing the waste products. The purpose of recycling is to redesign and convert waste into forms retaining as high value as possible in a circular economy. Contaminated waste products are challenging to recycle and reuse. Garbage can be converted into high-value products through mechanical/physical, thermochemical, and biochemical processes. The waste can be transformed into various forms of sustainable and clean energy products utilizing effective waste conversion technologies in the circular economy [9].

Regrettably, the underlying scientific/technical basis of the business is often neglected. As a result of this, enormous and overpriced Waste-to-Energy facilities were built producing very little energy from waste. Investors (e.g., in CleanTech sectors) often make an investment decision based on shallow scientific claims, optimistic financial and psychological factors as a consequence of that the basic science of the technology is not adequately evaluated. In addition to financial data and management of the company, the underlying scientific/technology base of the business should be considered. Science is supposed to be an essential pillar of a successful and sustainable business. The success of waste conversion technology applications depend on the following main factors:

- The underlying scientific/technical basis of the waste conversion process
- Adequate preparation of the waste feedstock
- Implementation of effective cleaning/scrubbing system to remove contaminants, especially, tars
- Adequate processing and mass & energy balance modeling
- Financial data based on mass & energy balance
- Local waste availability
- Waste energy conversion efficiency
- Quantity and quality of the produced products
- Applications of the products
- Cost-effectiveness of the project

The increasing amount of waste is one of the most challenging problems facing the world, which creates global environmental challenges. Contaminated waste products (e.g., plastic, paper, diapers, medical waste, waste biomass, and industrial byproducts) are challenging to recycle and reuse in the traditional way. Therefore, we have an urgent requirement to deal with the tremendous waste accumulation. At the same time, we have a tremendous business opportunity to convert waste into usable sustainable products. The circular economy can be based on efficient waste conversion technologies, such as traditional gasification, steam gasification, pyrolysis, and anaerobic digestion. Typically, the steam gasification reformation of waste is more efficient and cost-effective than other thermo-chemical and bio-chemical technologies and able to convert both biodegradable and non-biodegradable carbonaceous waste contents into higher value clean/renewable energy products. It is essential that sustainable waste management become an integral part of urban development. With the right approach, we could have a comprehensive and cost-effective solution for waste disposal, clean energy production, and sustainable product regeneration as a combination of biodegradable and non-biodegradable waste processing.

References

1. http://www.theworldcounts.com/counters/shocking_environmental_facts_and_statistics/world_waste_facts#top-facts

2. Strategy for a Waste-Free Ontario: Building the Circular Economy. https://www.ontario.ca/page/strategy-waste-free-ontario-building-circular-economy

3. https://www.msn.com/en-ca/money/topstories/china-just-handed-the-world-a-111-million-ton-trash-problem/ar-AAyW0WL?li=AAggNb9

4. Z. Kish, Perspectives on Waste-to-Energy Technologies, Quasar ScienceTech, March 2016, 5p. https://www.linkedin.com/pulse/perspectives-waste-to-energy-technologies-zoltan-kish-ph-d-?trk=pulse_spock-articles

5. Z. Kish, Clean Energy: Steam Reformation Technology, Lee Enterprises Consulting, June 2016, 3p. http://www.biofuelsdigest.com/bdigest/2016/06/22/clean-energy-steam-reformation-technology/

6. E. Dueck, Z. Kish, and D. Kirk, Pure Steam Reforming of Municipal Solid Waste, The International Solid Waste Association World Congress 2013, Vienna, 7th – 11th October 2013, 9p. https://www.researchgate.net/publication/264861433_Pure_Steam_Reforming_of_Municipal_Solid_Waste

7. https://www.yorkpress.co.uk/news/15479437.14bn-incinerator-starts-treating-waste/

8. https://waste-management-world.com/a/us4bn-waste-to-energy-deal-for-keppel-seghers-in-hong-kong

9. Z. Kish, Circular Economy and Waste Conversion, Quasar ScienceTech, January 2018, 2p. https://www.linkedin.com/pulse/circular-economy-waste-conversion-zoltan-kish-ph-d-/

About the Author

Dr. Zoltan Kish has a Ph.D. in Chemistry with over 25 years of diverse industrial and academic experience and contributed to more than 70 scientific publications. He has developed and managed complex research and development programs related to alternative/renewable energy, clean technologies, GHG, sustainability, and advanced materials applications, such as solar energy technology, ceramic engine & cutting tool components, materials processing, and electronics. Dr. Kish was the Director of Research & Development at two Canadian alternative energy companies where he focused on R&D and commercialization of unique Waste-to-Energy technologies and reliable scrubbing/ cleaning systems to produce clean and sustainable energy products. In response to global environmental challenges and the need for scientific evaluations of new technologies and advanced materials applications, he has established a consulting company - Quasar ScienceTech (www.quasarsciencetech.com) to provide multidisciplinary science and technology consulting in the areas of Natural & Applied Sciences, Clean Technologies & Energy, Waste Conversion, Technical Due Diligence, Climate Change Mitigation, Circular Economy, Sustainability, Innovation, and Advanced Materials Applications.