

MATERIAL CYCLES and WASTE MANAGEMENT RESEARCH

Vol. 33 No.2

March, 2022

Abstracts

[Special Issues: Transportation of Waste and Renewable Resources to Support a Decarbonized and Circular Economy]

1. Reduction of Carbon Emission and Work Hours for Municipal Solid Waste Collection and Transportation Operations using Information and Communication Technology

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Abstract

Many city governments are experiencing a shortage of workers in the fields of municipal solid waste collection and transportation operations. Extreme efficiency within the waste management field is required for both the collection and transportation phases. In addition, the goal of all decarbonization efforts must be to achieve "Carbon Neutrality by 2050". Recently, using ICT such as IoT, AI, and sensing technologies has become prevalent for decarbonization in various fields, including the waste management field. In this study, driving data from vehicles used in waste collection/transportation operations in urban and rural regions was collected using digital tachographs. We then developed methodologies to improve the efficiency of waste collection and transportation operations while also reducing CO₂ emissions with the use of this data. We actually test drove both current and improved routes which verifies an improvement in the efficiency of operations and CO₂ emission

reductions. In light of our results, we were able to construct waste collection and transportation management models which correspond to the characteristics of a wide variety of regions. We believe this model could be proposed for bringing greater energy efficiency and decarbonization measures into the waste management sector.

Keywords: municipal solid waste collection and transportation operations, efficiency of the operations, decarbonization, ICT, IoT

2. The Role of the Waste Transfer and Transport System in Supporting Wide-area Waste Treatment

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Abstract

The waste transfer and transport system is one of the most elemental technologies when taking wide-area waste treatment into consideration. In addition, when planning for wide-area treatment, it is necessary to consider the need for transfer-transport facilities depending upon the location of the waste collection area, incineration plant, final disposal site, etc. In this report, we analyze the current state of the waste transfer and transport system in Japan and also introduce application cases for wide-area treatment. The amount of waste transferred and the distance from the transfer point to the disposal site are important factors for considering the introduction of the transfer and transport system. Based on the results for Japan, there are currently 50 transfer stations in operation. 37 (74%) of the 50 stations in operation have a treatment capacity of 20 to 300 tons/day and a transportation distance of 10 to 50km. This means that the transfer station is being operated under a wide range of conditions. In addition, there are several methods being used to transfer waste at the transfer stations. The compactor container system is a method which is able to provide the most superior working environment due to its automatic operation. Furthermore, since the waste is compacted and loaded into a container, it is evaluated to hold the advantage in transportation efficiency. As a result of these points, the compactor container system has become the most popular system in Japan.

Keywords: wide-area waste treatment, collection and transport, transfer and transport system, transfer station, compactor container system

3. Efficiency in Long-distance Transportation of Waste and Recycled Products

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Abstract

Guun Company Limited (hereafter referred to as GUUN) is an industrial waste disposal company headquartered in the Kanazawa Industrial Park in Yokohama City, Kanagawa Prefecture. GUUN is manufacturing fuel mainly from wooden and plastic waste. Mr. Fujieda, the CEO of GUUN, developed the concept, "logistics as the key to sustainable waste disposal and recycling", and in keeping with this idea the company has conducted an optimization of logistics and has made the most use of ocean transport by boat to supply customers with waste-based fuel since its establishment.

Since the selling price of fuel derived from waste is compared with the prices of oil and coal, it has to be cheaper, and reduction of distribution costs is a major issue in product sales. For waste disposal from local governments, efficient collection and transportation of waste with limited financial resources and limited time is of great significance in order to protect the lives of citizens. In light of this, we introduce and summarize the examples from Yokohama City, Kawasaki City, and our company GUUN, so that they can be used to study the best transportation methods for waste collection and transportation and show the importance of transfer stations and economical large-scale transportation.

Keywords: transport of waste, transfer station, rail transport, ocean transport

4. Proposal of a Large-scale Heat Utilization System for Low-grade Unrecyclable Waste

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Abstract

Attempting to realize carbon neutrality in every sector of society has become an important issue relating to the mitigation of climate change. It is, however, difficult to achieve carbon neutrality in material industries, especially chemical and paper manufacturing. On the other hand, the waste sector is also making the necessary shift to a carbon-neutral system, with cost reduction being an important issue. Therefore, proposing a system that can solve the problems of both the waste sector and material industries at the same time is a possibility. It is also possible that combustible wastes which are difficult to recycle and are currently incinerated and used for power generation in each municipality, can be collected in petrochemical complexes where the waste can be efficiently used as a fuel to supply heat for their production processes. Since the energy density of waste is somewhat high, it is expected that the required long-distance transportation of waste is reasonable considering both the CO₂ emission reduction effect and its economic merits. It is my hope that the proposed system will be introduced and established as a new structure that can bring about synergistic effects in terms of both the environment and the economy.

Keywords: waste incineration, heat utilization, steam, material industry, industrial complex

5. Innovative Harvesting, Transport, and Yarding Systems in Forestry

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Abstract

In alignment with the goal of achieving carbon neutrality by the year 2050, forests and the forest industry have recently come into focus as a major player in CO₂ absorption. For Japan, one hurdle to this trend is the fact that half of the country's planted forests are now more than 50 years old. This means that if forests are maintained without cutting, carbon absorption in the future will not be possible. Proper management of forests, including thinning and reforestation, will therefore become extremely important as a means of contributing to the role of forests in sinking CO₂ for the future. For both forest and business sustainability, it will also be necessary to improve safety measures for forest workers and to boost their productivity. This paper describes some of the recent trends in automation and the development of new machines in forest operations with a focus on sustainability.

Key words: forest machinery, automation, felling, forwarding

6. Storage and Transportation of Renewable Energy by Ammonia

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Abstract

Ammonia is well known to be the most commonly used chemical product in the world, usually used as nitrogen fertilizer. Ammonia can be liquefied at a slightly higher temperature as compared to hydrogen or natural gas; and even at room temperature, it can be liquefied at a pressure of about 1MPa. These merits support the fact that it can therefore be transported and stored more easily than hydrogen or natural gas. The ammonia we used was synthesized using the Haber Bosch method, using nitrogen gas collected from the air and hydrogen gas produced from fossil fuels, but its value is largely determined by the production cost of hydrogen. In the renewable energy society hoped for the future, low-cost hydrogen would be produced in order to ensure adjustment power, and ammonia is expected to play an important role as an excellent energy carrier. In this paper, an overview of the ability of ammonia as an energy carrier and some technologies for easily producing hydrogen from ammonia are introduced.

Keywords: energy carrier, hydrogen, electrolysis, ammonolysis, ammonia absorbing material