CARE-North plus

Electric and low carbon waste management

Current situation in waste management and waste collection

Nearly 14,000 refuse collection vehicles (RCV) are in operation in Germany. Most of these vehicles operate with a conventional diesel power unit; only a few operate with electric power. Conventional RCVs, however, are paradoxically not designed for the stop and go requirements of waste collection. Instead, they are designed for continuous power (cargo transport over long distances) with long transport times and fewer stops. The power units currently in use are working outside their optimal operation point during household waste collection in urban areas. This results in high fuel consumption and low efficiency.

The requirements in the context of waste collection in urban area include frequent start-stop procedures and increased braking. In addition, the requirements differ between waste collection activities in urban areas and the transfer drive from and to the collection area.

Several years ago, the Nehlsen GmbH & Co. KG began using more environmentally-friendly and energy efficient hybrid RCVs in order to meet the requirements of efficient waste collection. Two vehicle types are currently in use: Plug-In Electric Vehicle (PHEV collection vehicles) – a combination of conventional and electric motor drive where the battery is charged from the grid; and Hybrid Electric Vehicle (HEV collection vehicles) – the battery is charged by engine or by recovering braking energy (see Figure 1). These systems are indeed technically proven but the acceptance by and the use in waste management companies is not popular so far.

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Fuel savings and avoidance of CO_2-emissions

By using hybrid RCVs for household waste collection, about 20 – 30 % of fuel and fuel-related CO_2 emissions can be reduced over the entire collection tour (depending on length and number of transfer drives). The savings increase to almost 40 % when considering only the waste collection itself (see Figure 2). These results (average values) were determined through various collection drives in different settlement structures and topography types in Bremen and Saxony (Comparison of conventional 3-axis collection vehicle and 3-axis-HEV).

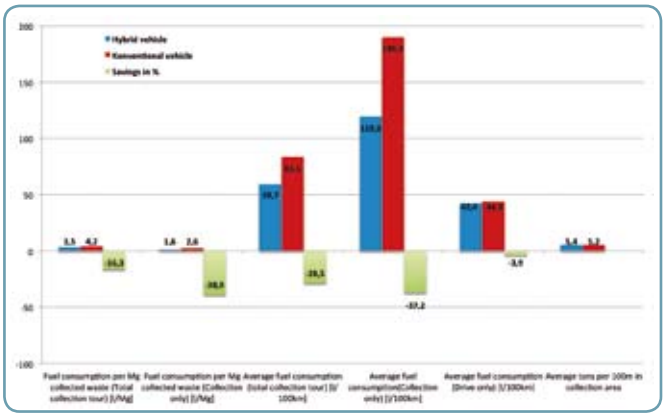

Figure 2: Research results on fuel savings of conventional 3-axis RCV in comparison to a 3-axis-HEV collection vehicle

Operation area of electric hybrid collection vehicles

In comparison to conventional RCVs, the operation area of hybrid RCVs is critical for utilising the advantages of this system. Research results have shown increasing advantages of HEVs with decreasing intervals of waste bins (see Figure 3).

Therefore, operation of HEV collection vehicles in urban settlements with small intervals of waste bins is more environmentally-friendly and energy efficient than operation in the rural area.

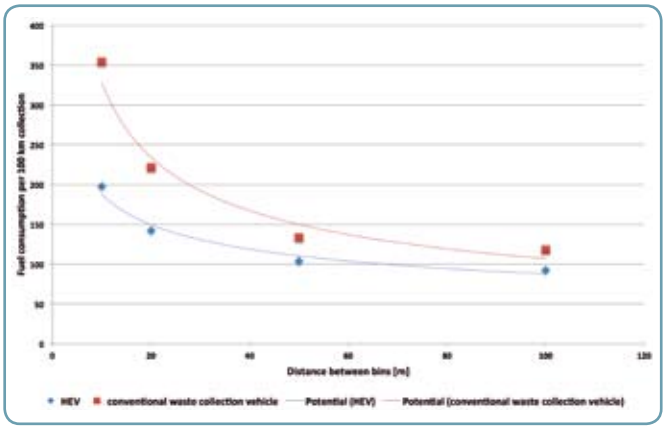

Figure 3: Fuel consumption of conventional vs. HEV collection vehicle depending on the distance between waste bins

Furthermore, a lengthy operation with HEV collection vehicles within the collection area is most advantageous for fuel reduction – the proportion of transfer drives must be kept as low as possible. In this operation mode, the advantages of these collection vehicles in relation to environmental and energy efficiency are best shown.

Reduction of noise emissions

Another advantage of hybrid collection vehicles are their significantly lower noise emissions compared to conventional RCVs.

In order to capture the system of waste collection holistically in terms of noise emissions, waste bins must also be considered in addition to the collection vehicles. The waste bins have a significant impact on the overall noise pollution from waste collection.

In this framework, field tests on noise emission measurements were performed on both RCVs and waste bins. The tests for determining noise emissions were carried out according to DIN EN 1501-4 und EU-RL-2000/14-EG. For the evaluation of the entire process of waste collection, additional measurements based on the methods according to DIN EN 1501-4 were performed (noise sources like starting and stopping from a waste bin location to the next one or passing are not covered by the standard specifications mentioned above).

First results of field tests show a reduction of noise by nearly 10 dB(A) when a HEV passes by in comparison to a conventional RCV. This corresponds to a noise reduction factor of about 3.

Due to noise-reduced waste bins, tests with waste bins according to EU-RL-2000/24-EG have shown reduced noise pollution of nearly 12 dB(A) in comparison to conventional waste bins.

Additional optimisation on noise-reduced waste bins result in a further reduction potential of another 10 dB(A). The experimental setup and the results are shown in Figure 4 and Figure 5.

Figure 4: Experimental setup for measuring of noise emissions caused by waste bins (left) and RCV (right)

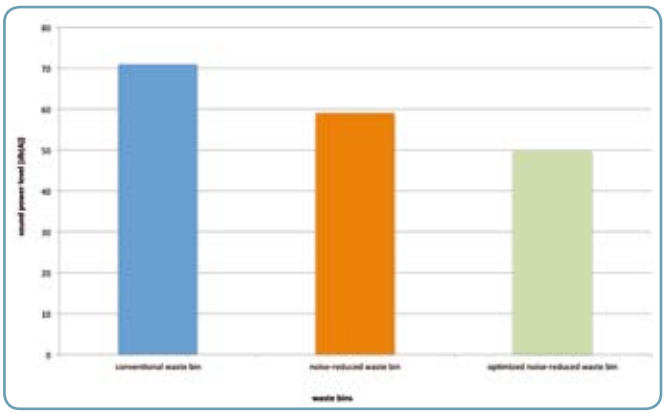

Figure 5: Results of noise emission measurements on waste bins according EU-RL-2000/14-EG

Overall, in the field of noise reduction, potential for optimisation still exists (e.g. optimisation of waste bins or improvement of lifting devices). Therefore, the noise emission tests also serve to identify individual noise sources and further reduction potential.

Nehlsen GmbH & Co. KG is doing research in this field to further reduce the noise emissions caused by RCVs as well as the entire process of waste collection (driving, lifting devices, compacting, waste bin movement). With further reduction of noise emissions, changes in waste logistics could perspectively be achieved (in compliance with pollution limit values). This, in turn, could help to reduce emissions and traffic congestion caused by RCV at peak times.

Use of information technology systems

The exploitation of the potential of more efficient waste collection requires the use of tour planning software, which implements hybrid-specific aspects. Nehlsen is currently developing such software in collaboration with partners from industry and science. The results obtained in research on emissions of hybrid vehicles contribute to the development of the software and will be implemented through appropriate parameters in the optimisation algorithm. This allows an optimal use of hybrid collection vehicles (see Figure 6).

The aspects considered include: road conditions and thoroughfare restrictions, inaccessible and advantageous routes (e.g. climb and slope – energy recuperation), preferred stops in response to waste bin distances as well as the sound volume.

Furthermore, the use of telematics solutions in all RCVs of Nehlsen's fleet is planned. Thus, it will be possible to constantly analyse and assess tour-specific data and tour operations.

Both systems will be combined in a logistic overall concept, which allows both strategically and operated tour planning for a permanent improvement of collection tours and adjustment to the dynamic conditions of constantly changing transport infrastructure.

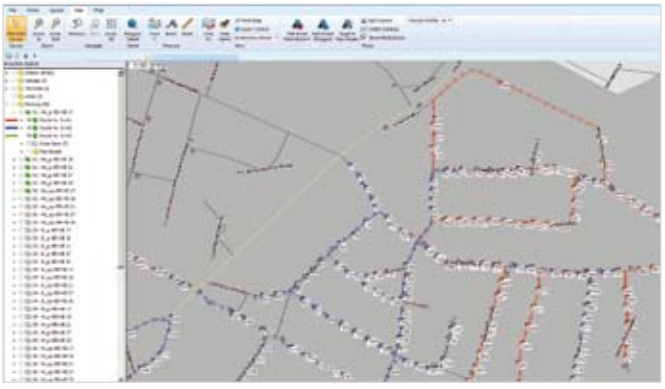

Figure 6: Example of tour planning by Transvision Route Planner

The potential of environmentally and energy efficient waste management in a nutshell

- By using electric RCVs in daily household waste collection, CO_2-emissions can be reduced significantly. It is of importance to keep hybrid collection vehicles at collection areas as long as possible and to keep the transfer drive as short as possible.

- In interaction with information systems such as route optimisation software (with implementation of electric/hybrid-specific aspects) and corresponding telematics systems for data collection and transmission, the potential for environmental and energy efficiency in waste management can be further improved. In addition, the resource consumption for the production of conventional fuel will be reduced and the CO_2 balance further optimised.

- Operation with hybrid RCVs is accompanied by a reduction of noise. This can result in perspective changes in the discharge time, which could lead to relief of traffic during the rush hours. Furthermore, due to the noise reduction through the use of hybrid/electric vehicles, a disposal company's employees and citizens will benefit.

- In the long term, the use of hybrid/electric collection vehicles provides great economic and ecological potential in waste management. Currently, the use of such vehicles is not yet economical due to high costs associated mainly with the initial investment. However, it can be expected that the investment costs will decrease and the operation will be more economical by continuous dissemination and further technological development.

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