

Accidents in the Sector of Collection and Transport of Waste

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Abstract—Waste management makes a large use of road transportation vehicles to collect waste from producers and transport it to various destinations, like waste-to-energy plants, recycling facilities and landfills. Waste transport then contributes to increasing the probability of roads accidents and the risk for population and operators. The present paper provides an overview of the causes of accidents involving waste collection/transport vehicles in Italy, with the aim of shedding light on this phenomenon. This research identified 1,200 newspaper articles on road accidents involving waste collection/transport vehicles from 1999 to 2022. An in-depth study was also carried out in four Italian cities, based on reports made to local authorities. Apparently, the number of accidents seems very low compared to national statistics on total road accidents. However, the real number of accidents may be much higher, since many accidents may have not been reported for different reasons discussed in the paper.

Index Terms—road transportation; safety; waste management.

INTRODUCTION

Waste management is closely related to energy production [1]-[3]. According to the waste hierarchy developed in the European Union (EU), recovering energy from waste is considered as the last viable strategy to avoid waste landfilling also in accordance with Circular Economy concepts [4]-[6]. Energy production from waste is usually referred to as Waste-to-Energy (WtE) processes, often related to thermal treatments (incineration, gasification and pyrolysis) of the residual waste fraction from the selective collection (SC) of municipal solid waste (MSW) and/or special waste, but biogas and biomethane production from waste biomass in anaerobic digestion (AD) plants has also considerably developed in the last decades. From the place of production to the place where energy is recovered, waste must be transported. The most adopted way of transporting waste is by road vehicles [7], [8], and this entails risks for citizens and waste operators due to the possibility of accidents caused by or involving waste transportation vehicles. Generally, the risk related to the road transport of waste depends on several factors, namely road

type and conditions, weather, drivers' skills and psycho-physical conditions [9]. Besides the waste fraction sent to WtE facilities, the development of SC (i.e., the separation of different waste materials by citizens and the industrial and commercial sectors) in many developed countries has enabled the activation of streams of recyclable waste resulting in additional collection and transport activities to recycling facilities [10].

Historically, the waste production of a country has been associated to its economic growth, since the better economic conditions are, the higher consumption rate occurs, and the higher waste production is expected [11], [12]. According to this conventional scheme, waste production is expected to increase in developing countries [13] but also in high-income countries during periods with increasing gross domestic product [14]. Consequently, if the contribution of other factors affecting the probability of occurrence of road accidents during waste transport do not decrease, an increasing number of accidents may occur under improving economic conditions.

The concept of Circular Economy (CE) and its forms of implementation, if mainly focused on initiatives to reduce the production of residual municipal solid waste (RMSW), may not reduce the overall production of waste materials. Improving SC rates is of course desirable as it reduces the amount of residual waste sent to landfills or WtE plants [15]. However, without preventing waste at the source, recyclable waste streams will be simply diverted to recycling facilities instead of landfills or WtE plants. Thus, these materials will still need to be transported. Therefore, despite obvious environmental advantages [16], reducing RMSW production by improving the collection of recyclable waste may not reduce the risk of accidents in the waste transportation sector. On the other hand, some CE initiatives may promote interesting actions at the source level and reduce the production of certain recyclable waste categories. For instance, the European Union's Member States recently proposed a regulation aimed at reducing the production and use of packaging materials [17].

Most of the publications available in the scientific literature on the risk induced by waste transport deal with hazardous waste [18], especially inflammable [19], radioactive [20] and toxic chemical [21] waste categories. However, the collection of non-hazardous MSW, including recyclable fractions and RMSW, may be more directly implicated in road accidents due to the higher amount of non-hazardous MSW with respect to hazardous waste: in Italy, in 2020 the share of hazardous fractions in household waste amounted to only 1.8%, while the share of hazardous fractions in industrial/commercial waste was limited to 6.7% [22]. In addition, MSW are generally produced and collected in urban areas, where the density of road vehicles and people is higher, and so is the probability of accidents.

This paper presents the methodology and the results of a survey on road accidents that have involved vehicles transporting waste from 1999 and 2022 in Italy. Italy has a well-developed selective collection system that has allowed increasing the SC rate from 17.9% to 64.0% in 2021, with a maximum of 88.6% achieved in the province of Treviso in 2021 [23]. The paper is intended to shed light on the safety of waste transport and on the potential implications for waste recycling, waste disposal and energy production from waste.

MATERIALS AND METHODS

The mentioned survey was based on the collection of data on single accidents involving municipal waste transport vehicles reported by Italian newspaper articles and available online. This research was based on an observation period from 1999 to 2022. The research was carried out by browsing search engines on the web and entering (in Italian) specific keywords for the event of interest and the specific sector. Specifically, the following keywords were used: “accident”, “fire”, “rear-end”, “collision”, “crash”, “overtaking”, “off-track”, “waste”, “trash”, “collection”, “transport”. In-depth research was also carried out by browsing the internal search engines of local and national online newspapers. Average data on road accidents involving waste collection and transport vehicles were also retrieved by the Italian Registry of Insurance Companies (ANIA) [24]. In addition, local police authorities were contacted to obtain statistics on the number of accidents reported involving service vehicles. This specific research focused on a sample of four Italian cities representing northern, central, and southern Italy: Turin, Florence, Bari and Palermo. This in-depth research was carried out to highlight the difference between accidents officially reported to authorities and accidents resulting in newspaper articles. The intention is to understand to what extent newspaper articles can be considered as significant sources of information for this matter. The first year with newspaper articles varies city by city, ranging from 2010 in Palermo to 2017 in Florence and Bari.

RESULTS AND DISCUSSION

The number of accidents involving vehicles operating the road transport of waste in Italy over the 24-year observation period (1999–2022), as reported by newspaper articles, is 1,200 (TABLE I). The major cause of accident is rear-end collisions between service vehicles and cars, accounting for

about 17.9% of the total accidents that were reported to insurance companies during the observation period. Other significant causes of accidents are the ignition of fires on board of service vehicles (17.2%), overturning (14.5%) and knocking down of pedestrians (9.0%). The latter was the main cause of death for the civil population, which provoked 59 victims, i.e. more than one third of the total number of civil victims. This is significant since 9% of the accidents involving service vehicles operating the collection and transport of waste caused about 39% of civil victims. The number of civil victims is about three times the number of waste operators involved in accidents during waste collection and transport services. The highest number of fatal injuries among waste operators (19) are due to the knocking down of operators by service vehicles, responsible for 30.6% of fatal injuries. Overall, the mortality rate following accidents involving service vehicles amounts to 5.2% and 12.7% of operators and civil population, respectively. The total number of victims from knocking down of pedestrians is the highest among all causes of accidents. As a final consideration, the main cause of death for civil victims did not provoke the death of operators and vice versa.

According to ANIA, waste collection and transport vehicles are characterized by a frequency of accidents that is double than the frequency of accidents of other insured road vehicles [24]. Compared to other vehicles, damage compensation costs for service vehicles are generally lower for damages to other vehicles or objects, but higher for damages to people. However, the frequency of damages to people is lower compared to other road vehicles; this means that the gravity of the damages to people in single accidents is higher with respect to damages made by other vehicles.

The results of the consultations with the local authorities of the four cities selected (Turin, Florence, Bari and Palermo) are reported in TABLE II, together with the number of relevant newspaper articles selected from the 1,200 articles identified. The accidents for which investigations by local authorities were reported were mainly caused by distraction, excessive speed, driver’s stress, lack of on-vehicle safety measures, lack of maintenance, lack of training of operators, improper behavior and use of illicit drugs or alcohol. It is therefore important for waste management companies to invest in mitigation measures, like internal control procedures on alcohol and drug consumption by drivers, renewal of the vehicle fleet, and safety courses for operators.

To oblige waste management companies to adopt such measures, the latter should be imposed at an institutional level and the compliance with the rules should be checked by trade associations (e.g., registers of waste management companies). The investments made would compensate the expenses for damage/injuries refund and prevent future accidents and, consequently, expenses.

According to the Italian Institute of Statistics (ISTAT), the total number of victims caused by road accidents during the period 2001–2021 (the longest available) in the whole country was 92,716, i.e. 4,415 victims/year on average [25]. According to the same statistics, road accidents explain about 0.7% of the whole mortality in the country.

TABLE I. TYPES AND NUMBER OF ACCIDENTS DURING WASTE OPERATIONS WITH SERVICE VEHICLES, AND RELATED NUMBER OF FATAL INJURIES TO OPERATORS AND CIVIL VICTIMS AS REPORTED ON ONLINE NEWSPAPER IN ITALY

Accident type	Number of cases	Fatal injuries	Civil victims	Total victims
Collisions between service vehicles and cars	215	4	31	35
Fires on service vehicles	206	0	0	0
Overturnings of service vehicles	174	11	0	11
Collisions between service vehicles and pedestrians	108	0	59	59
Collisions between service vehicles and heavy vehicles	97	7	13	20
Collisions between service vehicles and fixed obstacles	81	4	0	4
Collisions between service vehicles and mopeds/motorcycles	68	0	24	24
Off-track accidents	52	2	3	5
Collisions between operators and service vehicles	51	19	0	19
Injuries to operators for reasons other than falls from service vehicles, collisions with service vehicles and cars	47	0	0	0
Collisions with bicycles	43	0	19	19
Collisions between operators and cars	13	2	0	2
Falls of operators from service vehicles	9	1	0	0
Loss of waste from service vehicles	7	0	0	0
Accidents due to road failure	6	1	0	1
Accidents involving pedestrians during operations with service vehicles stopped	4	0	2	2
Other unspecified reasons	4	10	1	11
Near-miss accidents	3	0	0	0
Accidents occurred following thefts of service vehicles	2	0	0	0
Indirect damages induced by service vehicles other than for lube-oil losses	2	0	0	0
Lube-oil losses	2	0	0	0
Accidents involving animals	2	1	0	0
Operators' arrassements	1	0	0	0
Waste load explosions	1	0	0	0
Collisions between operators and mopeds/motorcycles	1	0	0	0
Collisions with trams	1	0	0	0
Total	1,200	62	152	214

TABLE II. NUMBER OF ACCIDENTS DURING OPERATIONS WITH SERVICE VEHICLES EFFECTIVELY REPORTED TO LOCAL AUTHORITIES AND BY NEWSPAPER IN FOUR SELECTED CITIES IN ITALY

Year	Number of cases reported from local authorities	Number of cases retrieved from press
Turin		
2013	8	1
2014	11	0
2015	15	0
2016	8	1
2017	6	2
2018	3	2
2019	12	0
2020	8	0
Florence		
2017	9	2
2018	12	0
2019	19	1
2020*	9	1
Bari		
2017	6	3
2018	3	0
2019	6	0
2020	3	2
Palermo		
2010	21	0
2011	15	0
2012	14	0
2013	16	0
2014	11	1
2015	17	0
2016	11	0
2017	5	1
2018	10	1
2019	10	2
2020	8	1
Total	276	22

Considering only the four cities (Turin, Florence, Bari and Palermo), the number of victims caused by road accidents during the same period was 2,179 (104 victims/year) [25]. Assuming the mean annual number of victims involved in accidents with waste service vehicles as a constant, 9 victims/year can be estimated on a national level, i.e. 0.2% of the annual mean number of victims caused by road accidents in the whole country.

After examination of the reports of local police authorities on road accidents involving waste collection and transport vehicles and the newspaper articles identified for the same observation periods, the number of accidents reported by the press in the four selected cities seems not particularly high compared with the official data of local authorities (TABLE II). Therefore, despite the apparently low number of accidents reported on the national level by newspapers, this phenomenon deserves further investigation, since it is possible that many minor accidents have occurred. Thus, the actual number of accidents might be higher. This may have negative implications on the safety of both citizens and waste operators, on the environment (due to the possible dispersion of waste) and on energy production (e.g., reduction of the incoming flow of waste to thermal WtE or AD plants). The low number of newspaper articles on accidents may be due to the deletion of older newspaper articles and, considering the recent years, the greater attention given to other topics, following COVID-19 and the growing international tension of the last years.

In addition, reports by local authorities may not be satisfactory sources of data either because:

- Operators and/or people involved might not have requested any intervention of local police officers in case of minor accidents, e.g. accidents without victims or significant damages to vehicles.
- Interventions may have been provided by other police forces.
- Operators and/or people involved may have filled in jointly agreed statement for insurance policies, which do not require the presence of police officers.

Focusing on the cities for which longer timeseries are available (Turin and Palermo), a slight decrease in the number of reported accidents is visible over time (Fig. 1). This decreasing trend agrees with the trend of road accidents occurred in Italy during the same period [25]. It is worth mentioning that national statistics only provide the number of accidents with injuries and not the total number of accidents.

Zooming on the number of accidents every 100,000 inhabitants, three cities are in the range 1.4-1.9 whilst one shows a value higher than 5 (Fig. 2). The last case refers to Florence. An explanation could be the very high presence of tourists in the territory of the municipality (about one order of magnitude higher than the others). Data of inhabitants and tourism come from [26].

At the European level, the transport of waste between EU Member States is regulated by the Regulation (EC) No. 1013/2006 [27], which establishes procedures and control strategies for the shipment of waste, according to origin, route

and destination. However, the EU delegates to the single Member States the regulation on the transport, collection and management of waste within their borders. In the specific case of Italy, the regulatory framework includes a series of regulations that oblige waste management companies to be part of a register of environmental management companies and to comply with quality standards regarding vehicle fleets and the management of collection centers.

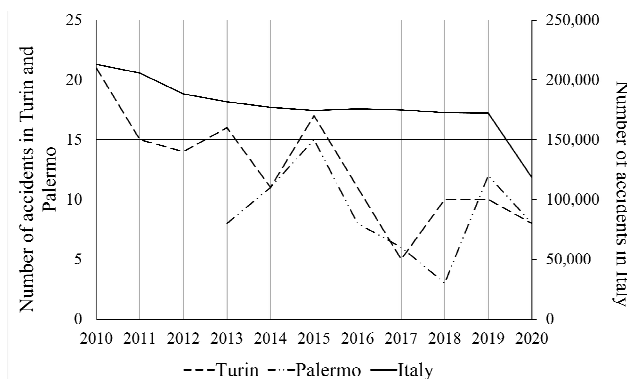


Figure 1. Trends of the number of accidents involving waste collection and transport vehicles in Turin and Palermo, as reported by local authorities, and trend of the number of accidents with injuries in Italy during the period 2010–2020.

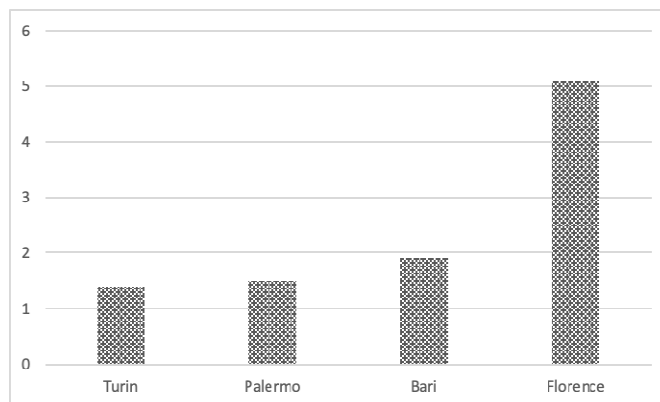


Figure 2. Yearly number of accidents every 10⁵ inhabitants

CONCLUSIONS

Road transportation is an essential part of waste management that allows for the capillary collection of waste and its transfer to recycling facilities, WtE facilities and landfill sites, following the waste hierarchy. The present study showed that the level of attention of media may underestimate the real impacts that accidents caused or suffered by waste collection/transport vehicles can have on damages to objects or other vehicles, physical injuries and mortality. As a result, the incidence of the road transport of waste is potentially higher than what appears to be. Further investigations are needed to define a more complete picture of the situation. Specifically, collaborations with ANIA and equivalent databases in other countries would allow retrieving detailed data on accidents involving waste collection/transport vehicles

and their effective incidence on both total road accidents and societal costs. Besides the importance of retrieving data on this topic, it is also crucial to identify best practices to prevent accidents during waste collection/transport activities.

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