Transport of Dangerous Goods by Road: Preliminary Data Analysis in March 2020 During COVID-19 Emergency in Italy

Fabio Borghetti*, Roberto Maja

Politecnico di Milano, Dipartimento di Design, Laboratorio Mobilità e Trasporti, Via Durando 38/A, 20154, Milano, Italy
fabio.borghetti@polimi.it

The work proposes a preliminary analysis of the transport of dangerous goods in Italy during the lockdown caused by COVID-19 in March 2020. Using a monitoring network able to detect the orange panel (UN and KEMLER number), it was possible to analyze the data related to the gates near Brescia (Regione Lombardia) and Trecate (Regione Piemonte). The first gate is located on area which is one currently most affected by COVID-19 in the whole of Italy. The second gate is placed in a suburban area near the city of Trecate in the province of Novara. This gate can be considered significant because it is close to an important industrial pole where there are several chemical plants also for the processing of hydrocarbons. The analysis was performed considering three representative substances: gasoline, diesel fuel and oxygen. The first substance could reasonably be associated with the transport of people (motor vehicles), the second with the transport of goods (heavy vehicles) while the third could be even used in the medical and hospital sector as a result of the greater number of people having contracted COVID-19. Several analyses were carried out in order to compare the number of transits of hazardous goods detected with a reference period.

1. Introduction and aim of the analysis

The global emergency associated with COVID-19 is having in Italy important impacts on the transport system and in particular on the goods distribution; the transport of dangerous substances travelling by road is also affected. The aim of this work is to perform a preliminary analysis of the variation in the type and quantity of dangerous substances that passed through Italy in March 2020. Obviously, it would be impossible to know and process the data on the whole national area: it was therefore decided to analyze two gates located respectively in the Regione Lombardia and Regione Piemonte considered representative. The first gate is located on the motorway A4 near the city of Brescia, which is currently one of the areas most affected by COVID-19 in Italy. The second gate is located in a suburban area near the city of Trecate in the province of Novara. This gate can be considered significant because it is close to an important industrial pole where there are several chemical plants also for the processing of hydrocarbons. March 2020 is the first month of national lockdown of which data are available at this time (April 2020). Although it is a limited time horizon, it is considered useful to provide a preliminary analysis aimed at knowing the trend and therefore the impact of this type of transport. The analysis was performed considering three representative substances: gasoline, diesel fuel and oxygen. The first substance could reasonably be associated with the transport of people (motor vehicles), the second with the transport of goods (heavy vehicles) while the third could be used in the medical and hospital sector as a result of the greater number of people having contracted COVID-19. The following comparison was made for each of the two gates:

- 1° quarter year 2019 and year 2020 - all substances
- Top 10 substances year 2019 and year 2020
- Number transits of gasoline, diesel fuel, oxygen on a monthly basis - March 2019 and March 2020

Further analysis and evaluation will then be possible, considering a longer time period, a larger number of gates and especially by cross-referencing this data with other available information. The analysis was carried out using the monitoring network developed within the Interreg IT - CH DESTINATION project aimed at assessing the risk associated with the transport of dangerous goods (Studer et al., 2012; Borghetti et al.,

2018b). The monitoring network is made up of 32 gates located on different roads of the project area (Borghetti et al., 2018a). Figure 1 shows the geographical framework and location of the two cameras (gates) used in this study.

Figure 1: Location of the two cameras (gate) used in this study

As an example, the recognition of vehicles used for the transport of hazardous goods by reading the orange panel (UN and KEMLER numbers) is shown in the Figure 2.
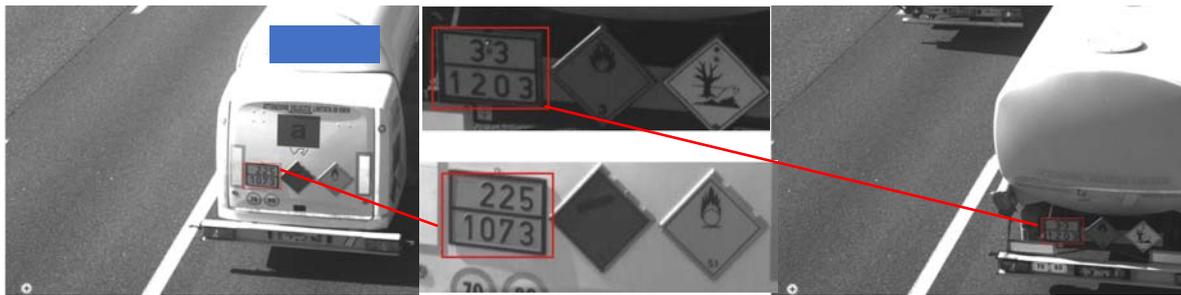

Figure 2: Example of orange panel scanning with OCR - Optical Character Recognition camera

The use of data related to the transport of hazardous substances can support analytical models for risk analysis (Bubbico et al., 2006; Conca et al., 2016). In addition, it is possible to estimate not only natural and anthropic targets (built-up areas, industrial zones and healthcare, education and commercial facilities) but also road users (stopped in queue) potentially exposed following a relevant event (Studer et al., 2018).

Figure 3 shows the total number of transits detected by the Brescia and Trecate gates with references to the first quarter of 2019 and 2020. With regard to the month of March 2020, it should be noted that the camera of Trecate Gate did not work for the whole month: due to a technical failure it recorded the passage of vehicles from day 1 to day 26. However, it should be noted that in March 2020 there was a significant reduction in the number of dangerous substances detected in comparison with both the previous two months and March 2019.
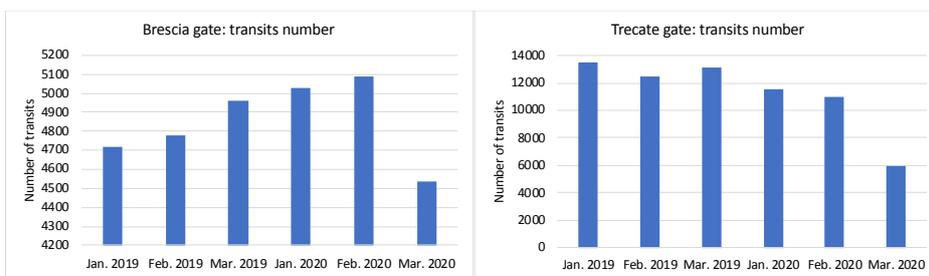

Figure 3: Transit trends of dangerous goods detected by the Brescia and Trecate gates in the first quarter of year 2019 and year 2020

The following is a detailed analysis of the Brescia and Trecate gate.

2. Brescia gate analysis

A further analysis deals with the 10 most transited hazardous substances detected by the camera. In particular, a comparison was made between March 2019 and March 2020 in order to identify possible variations as shown in Figure 4. Although in reduced quantities, the first two substances are diesel fuel and gasoline in March 2020 and the reduction is -17% and -23% respectively. Oxygen +15% and nitrogen are growing in quantities, probably used in hospitals and medical care while the aviation fuel that could be used for air transport is reduced.
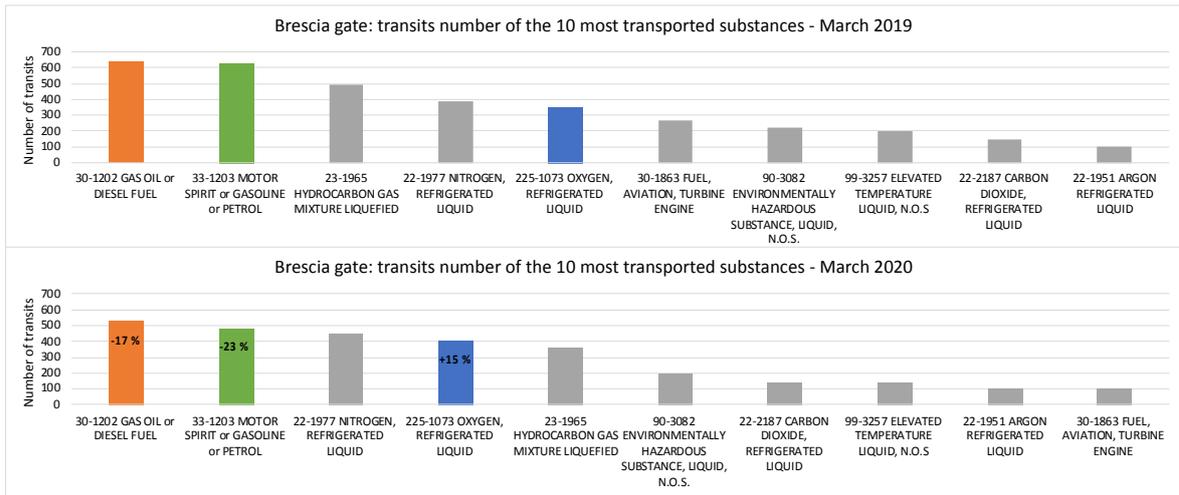

Figure 4: Number of transits of the 10 most dangerous goods transported and detected by the Brescia gate in March 2019 (top) and March 2020 (bottom)

Figure 5 shows the transits detected by the gate between January 2019 and March 2020 with respect to the gasoline, diesel fuel and oxygen.
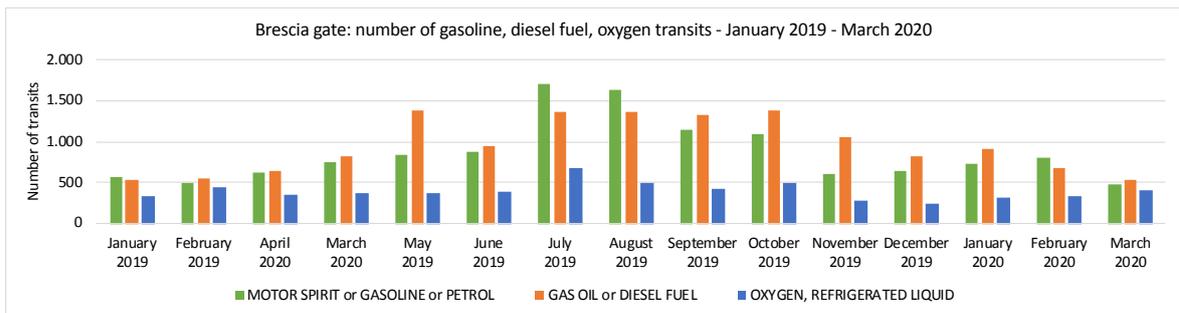

Figure 5: Number of transits of gasoline, diesel fuel and oxygen detected by the Brescia gate between January 2019 and March 2010

The three substances considered in this study, gasoline, diesel fuel and oxygen, are analyzed in March 2019 and March 2020. Figure 6 shows the trend of the three substances during the 31 days of March 2019 including weekends. The number of transits is more or less uniform during the month with evident reductions in transit during the weekend. The transits of gasoline and diesel fuel are almost double those of oxygen. The dotted lines represent the trendlines.
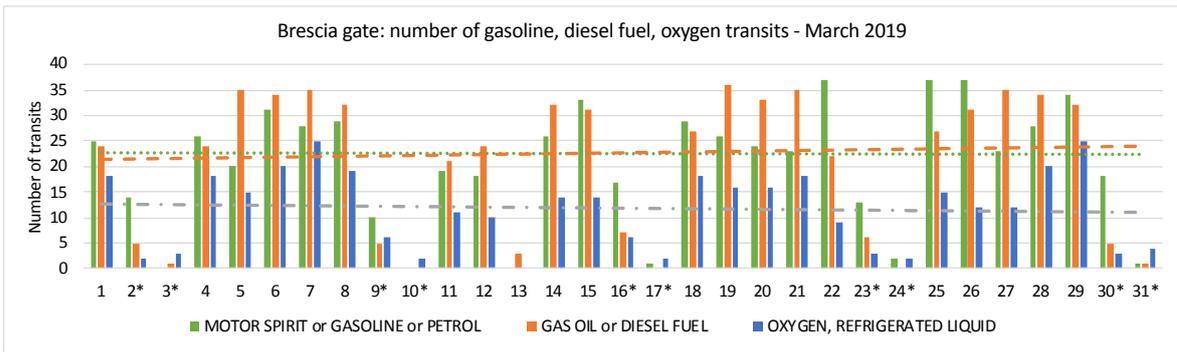
Figure 6: Trend of gasoline, diesel fuel and oxygen transits detected by the Brescia gate in March 2019. Weekends are marked with *

The trend of the three substances during the 31 days of March 2020 is shown in Figure 7. In comparison with March 2019, it can be seen that the three substances have a different pattern. The number of gasoline and diesel transits is in line with the previous year until about the middle of the month when there is a strong reduction probably associated with the lockdown of most of the country's activities.

Oxygen transits, on the other hand, are cheaper than gasoline and diesel fuel, but are uniform throughout the month; probably a large part of the oxygen is used in hospitals and medical sector. Even in this case, there are clear reductions in transit during the weekend. The dotted lines represent the trendlines.
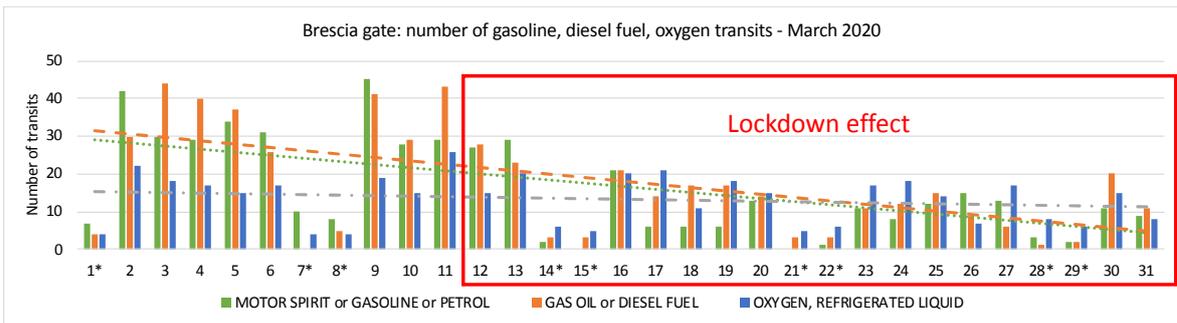

Figure 7: Trend of gasoline, diesel fuel and oxygen transits detected by the Brescia gate in March 2020. Weekends are marked with *

3. Trecate gate analysis

The 10 most dangerous substances that have passed through and therefore detected by the camera are shown in the graph in Figure 8. As already mentioned, this camera is located near an industrial site. A first analysis between March 2019 and March 2020 confirms a reduction in the number of vehicles detected. As far as the type of substance is concerned, it is noted that gasoline is still the most transported with a reduction of 60% and diesel fuel remains in fourth place with a reduction of 46%. Oxygen transport is reduced by about 31 %.
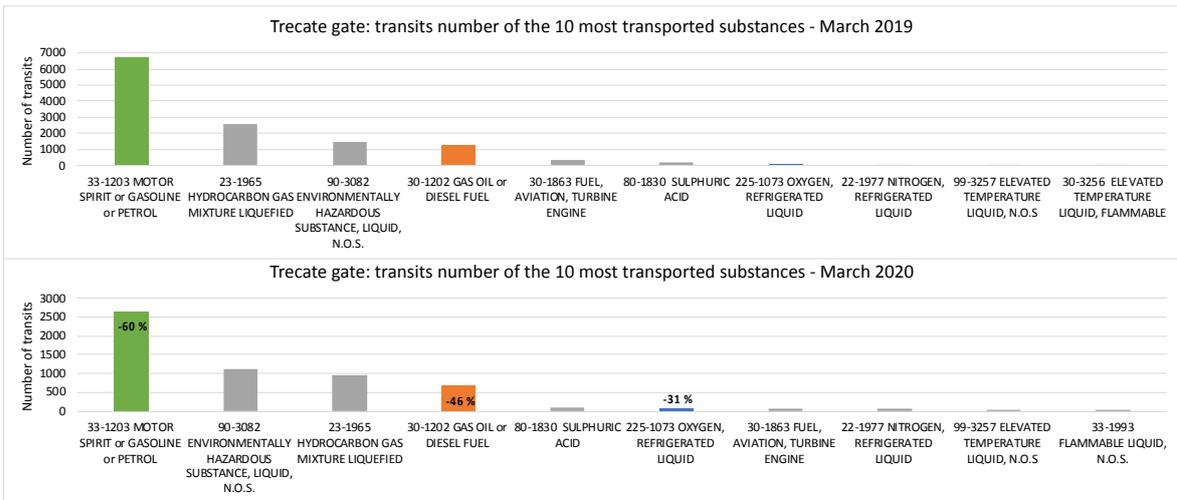
Figure 8: Number of transits of the 10 most dangerous goods transported and detected by the Trecate gate in March 2019 (top) and March 2020 (bottom)

Figure 9 shows the transits detected by the gate between January 2019 and March 2020 with respect to the gasoline, diesel fuel and oxygen.
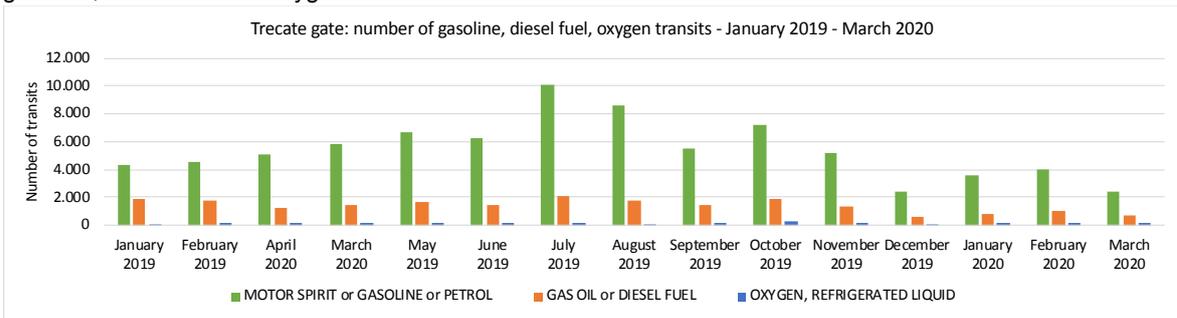

Figure 9: Number of transits of gasoline, diesel fuel and oxygen detected by the Trecate gate between January 2019 and March 2010

Even for the Trecate gate, Figure 10 shows the trend of the three substances during the 31 days of March 2019, including weekends. In general, the number of passages is more or less uniform during the month with evident reductions in transit during the weekend. The transits of gasoline are much higher than those of diesel fuel while the transport of oxygen is quite limited in this context. The dotted lines represent the trendlines.
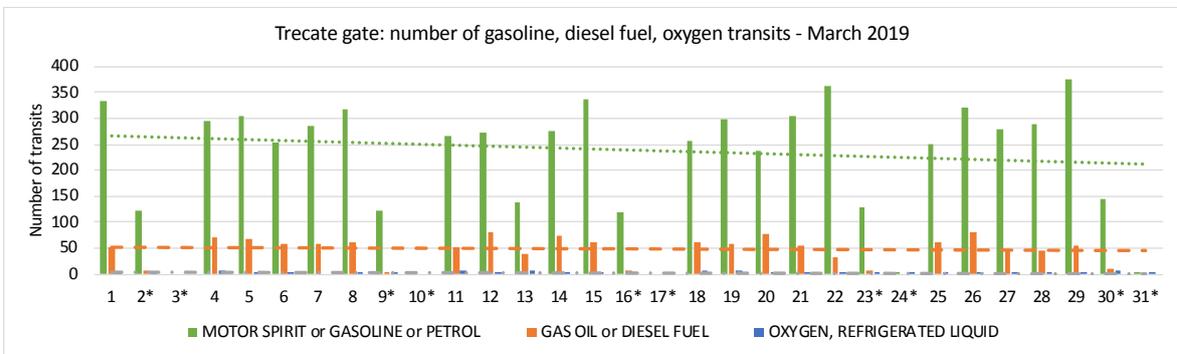

Figure 10: Trend of gasoline, diesel fuel and oxygen transits detected by the Trecate gate in March 2019. Weekends are marked with *

As mentioned above, in March 2020 the camera worked from day 1 to day 26. However, it is still possible to know the trend of the three substances as shown in the graph in Figure 11. In comparison with March 2019, it can be seen that the three substances have a different trend. The number of gasoline transits is constant in the first half of the month and then there is a strong reduction probably associated with the lockdown of most of the country's activities. As far as diesel fuel is concerned, a different trend was also observed during the month: the passages recorded in the second half of the month were lower than in the first half. It is assumed that the difference between gasoline and diesel fuel distribution is basically associated with the type of users: in the first case these are vehicles used for private transport while in the second case they are vehicles used for the transport of goods (e.g. food) which therefore continue to circulate even during lockdown, even if in reduced quantities. The transport of oxygen at this gate remains very low compared to gasoline and diesel. The dotted lines represent the trendlines.
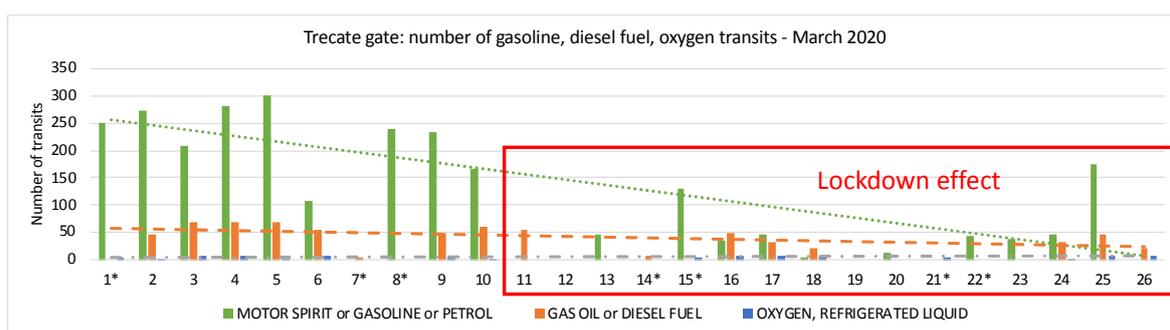

Figure 11: Trend of gasoline, diesel fuel and oxygen transits detected by the Trecate gate in March 2020. Weekends are marked with *. Due to a technical failure, the camera worked from the 1st to the 26th of March

Conclusions

The paper presents a preliminary analysis of the transit of dangerous goods in Italy in March 2020 during the lockdown caused by COVID-19. The two gates analyzed are placed near the city of Brescia and Trecate: the first gate is located in one of the areas most affected by COVID-19 while the second one is near an important industrial area in northern Italy where hydrocarbons are produced. The three substances analyzed are: gasoline, diesel fuel and oxygen. With regard to the month of March 2020, it should be noted that the camera of Trecate gate did not work for the whole month: due to a technical failure it recorded the passage of vehicles from day 1 to day 26. With reference to the Brescia gate, comparing the month of March 2020 to March 2019, there was a reduction of 23 % and 17 % in gasoline and diesel fuel transits respectively. The transport of oxygen, on the other hand, increased by 15 %. At the Trecate gate there was a sharp reduction of 60 % and 46 % in gasoline and diesel fuel transits compared with March 2019, respectively. For both gates the lockdown effect was observed in the second half of March 2020.

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