Risk Assessment Modeling of Air Pollutants Emissions in Beihaghi Terminal

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Extended Abstract

Introduction
Public transportation system is a suitable solution to organize transportation in urban areas. This system reduces the demand for private car or taxi for economic savings. Public transport will not only reduce the use of private vehicles, but it will also reduce traffic and air pollution. The public transportation system of buses seems to be the excellent as one of the most efficient form of the public transportation systems. Bus terminals play an important role in the regulation of urban transportation. However, these terminals have the potential to become sources of air pollution.

The mathematical model can easily estimate emissions of terminal vehicles and concentrations of pollutants. By alternative methods of sampling and measurement model, it can be possible to review existing situation and to anticipate the future in a more quick and costless way. If needed, it can be subject to examination and sampling. The purpose of this study is to assess the risks the persons in those terminals are faced with. These persons are including drivers, office workers and travelers to the area. The air pollutants CO, NO_2, and SO_2 are presented at the terminals by modeling and PM_{10} Payments.

Materials and Methods
IVE model is designed to estimate emissions from motor vehicles. The purpose of the model is to control strategies and transportation planning, to predict how different strategies will affect local emissions, and to measure progresses for reduction of emissions over time. Input data of this model are vehicle types, number of vehicles, their presence time in terminal, engine type, age, exhaust control technology, fuel type and speed. Moreover, other data are the essential geographical and meteorological information collected by documents review, questionnaires and statistical modeling. According to the traffic in the terminal and at different hours of the day, the average amount of estimated emissions of air for NO_2, PM_{10}, CO and SO_2 were determined. This is one of the BREEZE AERMOD inputs. Terminal resource modeling for air pollutants to a level that is unevenly spread is also considered. In this way, surface coordinates and the release of three terminals are needed.

Some field works were required for more accurate determination of concentrations of air pollutants concentration. Concentrations of air pollutants in the desired period of time were estimated without taking into account the effects of air pollutants at the terminal air pollution monitoring stations near the terminals. Exposure to the range of terminal points was needed to determine how the output data set is analyzed. Finally, the required parameters and output were set in a given period of time. After completing all the input data, the model was run with known concentrations of air pollutants.

Two groups of people were directly exposed to air pollutants in the terminal. A group was the drivers and terminal staff that were highly subject to the air pollutants and the other group was the passengers with different patterns of exposure to air pollutants. In this research, we used risk assessment method of RAIS from USEPA.

Results and Discussion
Emissions of air pollutants and their concentrations in the IVE model and BREEZE AERMOD model have been used for risk assessment. Air pollution emissions are calculated by IVE model. The output data of IVE model is used as the input data for the BREEZE AERMOD model which estimates the concentration of pollutants. Finally, the cancer and non-cancer risk of CO, NO_2, SO_2 and PM_{10} concentrations is calculated by the RAIS,

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which is achieved by the use of non-cancer and cancer risk assessment of pollutants, quantitative assessment of risks from inhaled pollutants and persons that are affected. Searches performed for the pollutants of NO_2, CO and SO_2 gradients cancer is currently not available. Only the cancer risk of PM_{10} has been calculated by its cancer slope factor. After calculation of the cancer risk for the population, the cancer risk is multiplied by the number of people in contact. Inhalation of hazardous air pollutants per passenger in Beihaghi Terminal and HQ_{inhale} results for the different groups are shown in Table 1.

Table 1. Cancer and non-cancer risk assessment of air pollutants in the Beihaghi Terminal

	Chemical	Chronic RfC (mg/m^3)	Concentration (ug/m^3)	Inhalation Ambient Air Non-carcinogenic CDI	Inhalation Ambient Air Carcinogenic CDI	Inhalation Ambient Air HQ	Inhalation Ambient Air Risk
Drivers	CO	0.023	2500	0.6850	294	1.32	-
	NO_2	0.047	923	0.1610	69.2	2.38	-
	SO_2	0.262	80	0.0219	9.39	0.0369	-
	PM_{10}	5.000	170	0.0466	20	0.0041	0.00264
Site Personnel	CO	0.023	2360	0.6470	277	2.81	-
	NO_2	0.047	333	0.0912	39.1	1.94	-
	SO_2	0.262	80	0.0219	9.39	0.0837	-
	PM_{10}	5.000	80	0.0219	9.39	0.0044	0.00282
Official Personnel	CO	0.023	2360	0.49600	212	2.16	-
	NO_2	0.047	333	0.06990	30	1.49	-
	SO_2	0.262	80	0.01680	7.2	0.0641	-
	PM_{10}	5.000	80	0.01680	7.2	0.0034	0.00216
Passenger	CO	0.023	2360	0.0269	3.85	0.117	-
	NO_2	0.047	333	0.0038	0.54	0.0809	-
	SO_2	0.262	80	0.0009	0.13	0.0035	-
	PM_{10}	5.000	80	0.0009	0.13	0.0002	0000390.

The non-carcinogenic hazard quotient estimated for CO express that the most HQ is for site personnel with 2.81, this exceed the unit. If the quotient is less than 1, then the systemic effects are assumed not to be of concern; if the hazard quotient is greater than 1, then the systemic effects are assumed to be of concern. HQ for official personnel is 2.16 and for drivers is 1.32, both more than unit. Therefore, these three groups of people are in risk of CO inhalation. The HQ estimated for passengers is 0.117 which is less than unity and they are not in risk of CO inhalation. The NO_2 HQ estimated for drivers is 2.367 who are in the most risk in comparison to the other groups. The HQ for site personnel is 1.94 and for official personnel 1.49, which is more than unity. Thus, these people are in risk for NO_2 inhalation in the passenger terminal. The SO_2 HQ for drivers is estimated about 0.0369, for site personnel 0.0837, for official personnel 0.0641, and for the passengers 0.0035. These are less than unity for all groups of people. None of people in the passenger terminal are in the risk for SO_2 inhalation and non-carcinogenic risk. The PM_{10} hazard quotient for all groups of people is less than unity and no one is in the non-carcinogenic risk of this pollutant.

The hazard index is the sum of hazard quotients. Hazard Index is calculated by adding hazard quotients for each chemical across all exposure routes. Hazard index for the drivers is 3.737, for site personnel 4.838, for official personnel 3.718, and for passengers 0.202. Consequently, the site personnel are in great risk in this transportation terminal. This population is in the open area and exposed to vehicle exhaust emissions. The official personnel and drivers are also prone to the effects of non-carcinogenic risks of these contaminants. Drivers have the same situation to the site personnel but with the different frequency of contact. Official personnel at the terminal work 8 hours a day in the buildings, but due to indirect emissions from vehicles. The risk Index indicates a low risk of inhalation of air pollutants for passengers in the terminal. The CO pollutant has the greatest share of risk which is 58 percent and then the NO_2 with 40 percent in the passenger terminal.

Conclusion

In this research, risk assessment based on concentrations of inhaled air pollutants is modeled by BREEZE AERMOD. Hazard index for drivers of all air pollutants is the most for site personnel and the least for passengers 0.202. The risk inhalation of air pollutants is minimal for passengers in the terminal. Most persons working in the Beihaghi Terminal and the drivers are at the non-cancer risks. Pollutants are the greatest share of the risks are emissions of NO_2 and CO. Share of NO_2 emissions is 64 percent and share of CO emission is 35 percent of the whole pollution in the Terminal.

Cancer risk assessment using cancer slope is appeared only for particulate matter emission. Carcinogenic risk assessment for PM_{10} is estimated to be for the population inhaled. The risk of PM_{10} inhalation for the drivers is high, meaning that 3 of them may suffer from cancer in their lifetime. There is also risk for carcinogen illnesses for one of the site personnel and of the passengers in their lifetime. Therefore, the drivers are exposed to most of the cancer risks. In general, in this terminal the risk of cancer is highly increased.

Keywords: AERMOD model, air pollution, city terminal, IVE model, risk assessment.