

THE IMPACT OF DIESEL FUELS' COMBUSTION IN CARS ON THE URBAN AIR SO₂ POLLUTION IN TIRANA, ALBANIA

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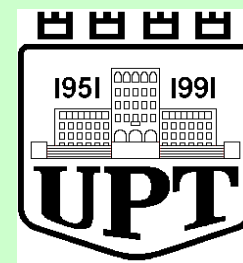
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Vehicle Fleet in Albania:

- 80 % of it there are Diesel cars which are mostly second hand vehicles imported from neighbor countries after the 90s.

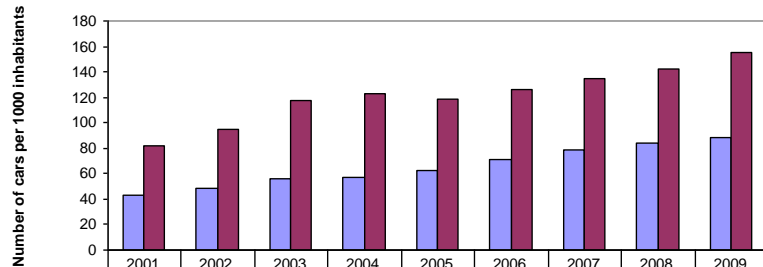
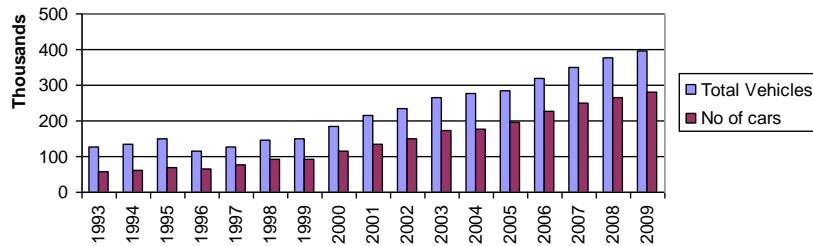
- Number of private cars is slightly more than 70 % of the total number of registered vehicles in 2009

- The cars produced in the period 2006-2009, which are registered as brand new cars purchased in these years, is less than 5 % of the total number of vehicles

- The number of cars per 1000 inhabitants has been almost double in the capital compared to this figure for the whole country in the last decade.

- In 1990, there were 20200 vehicles and only 2400 cars in the whole of Albania!!! It means that there were 6.2 vehicles for 1000 inhabitants and 0.73 cars for 1000 inhabitants!!!

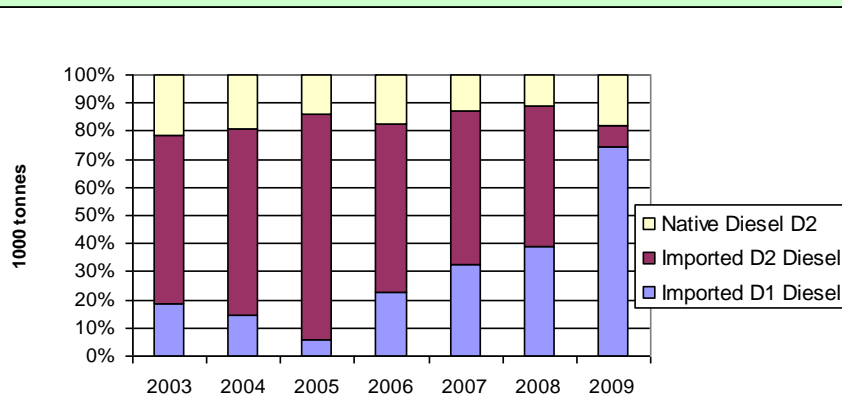
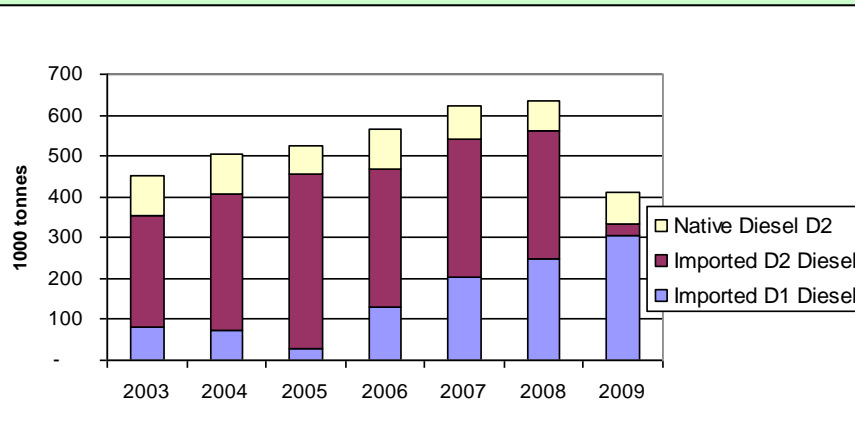
Progress of the number of vehicles and of the number of cars in Albania in the period 1993 - 2009



	2001	2002	2003	2004	2005	2006	2007	2008	2009
Albania	43.51	48.16	56.33	57.15	62.21	71.48	78.69	83.54	88.05
Tirana District	81.68	95.33	117.25	122.68	118.4	125.62	134.7	142.43	155.12

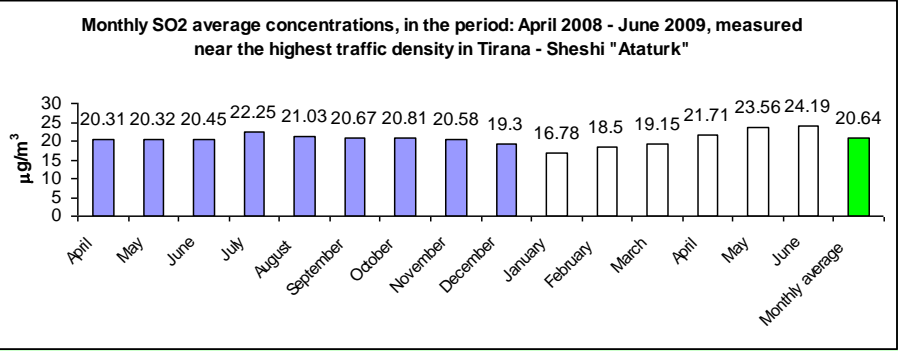
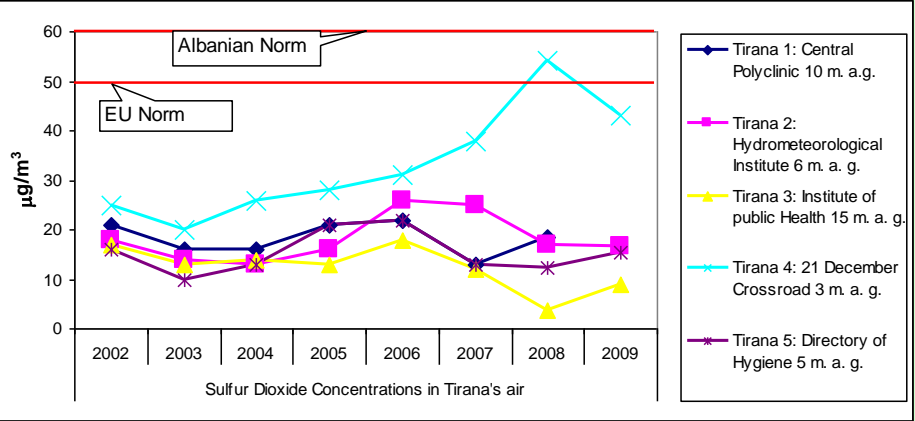
Diesels consumed in Albania

- In Albania up to 2009, the Diesel vehicles used
 - Diesel D2 which contained sulfur in the range of 0.05 – 0.2 % in mass and
 - Diesel D1, otherwise named “Eurodiesel”, which contained less than 0.05 % (in mass) sulfur in it, according to the customs’ classification.
- The Diesel produced in Albania up to 2008 was of the type D2 due to its high sulfur content and the lack of a desulphurization plant in the country.
- The quantity of diesels consumed by the Albanian market has annually increased in the last decade, as the Figure 3 shows.
- However, there was an exception of this trend in the year 2009, due to the banning of the import of the Diesel D2 type by the Government, and also due to the effects of the world financial crisis on fuel consumption in Albania.

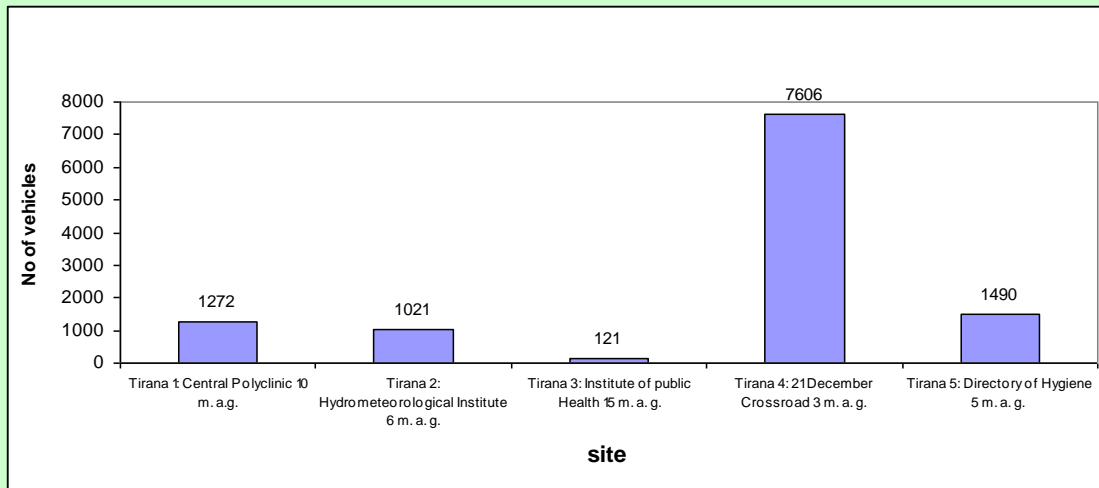


Sulfur dioxide concentrations in Tirana

- It was necessary for the authors of this paper to undertake this research in 2008-2009 in order to observe the Diesel quality regarding sulfur content in Diesels traded in Albania and their impact on the SO₂ urban air pollution.
- Tirana was chosen as the City on which to observe the SO₂ air concentrations because in Tirana District circulate over 36 % of the total vehicles that Albania has (MTTPW, 2010) and lives 23 % of the population of the country (INSTAT, 2010) and also because SO₂ is one of the indicators of the urban air quality.



Sulfur dioxide concentrations in Tirana



Total number of vehicles passing by each Air Quality Monitoring Site in Tirana, in the year 2007. (Source: MT, 2008).

- Concentrations of SO₂ measured in Tirana respect the Albanian standard in all monitoring stations, nevertheless they show an annual increase especially in the “heavy traffic” cross road named formerly “21 December”, and today “Ataturk” Square, which for the year 2008 passed the EU norm for this air pollutant.
- The much higher SO₂ concentrations in the Tirana 4 monitoring point are explained by the much higher number of vehicles passing daily in this monitoring site, based on the traffic numbering in Tirana’s roads in the morning rush hour in 2007 (MT, 2008).

Material and methods

- Because there are not many published data on the Fuels' quality in Albania, in order to complete this research, information was obtained from various Governmental Institutions, such as Ministries of the line, Agencies and Directorates, as presented in the References and Source of data for each case that the data was used by itself or when it was combined with data from several Institutions to compile certain graphs.
- For the experimental part, Diesel samples of one liter were taken in sterile plastic bottles from various fuel stations along Tirana- Durres and Korça – Kapshtica highways. For a reference of the fuel used in an EU country, diesel brought from Greek fuel stations was analyzed regarding its sulfur content at the same time and with the same equipment that the other diesel samples were analyzed.
- The equipment used to analyze the sulfur content in Diesel fuels is Multi EA 3100 Analytik Jena. Pyrolysis is used for the breakdown of the substances in the Multi EA 3100, with subsequent thermal oxidation of the pyrolysis products.
 - Reaction taking place can be summarized as below:
 - $R-S + O_2 \rightarrow SO_2 + CO_2 + H_2O$ (1)
- R – represents the organic substances containing carbon in the Diesel to be analyzed.

Results and Discussion ...

Table 5: Summary of the average sulfur content (in mass percentage) of the fuels traded in Albania in 2008, according to their categories.

Diesel D1 imported	12 samples	0.021
Diesel D2 imported	6 samples	0.102
Albanian D2 diesel	3 samples	0.16
Diesel brought from Greece	6 samples	0.0027

Table 6: Average amount of S and SO₂ per inhabitant in Albania in 2008.

	S mass %	Diesel quantity in kg in 2008	Total S in Diesels in kg
Diesel D1 imported	0.021	246000000	51660
Diesel D2 imported	0.102	316000000	322320
Albanian D2 diesel	0.16	71000000	113600
Total amount of Sulfur in Diesels in kg			487580
Average amount of SO ₂ , supposing that S is oxidized 100 % in SO ₂ M _{SO2} = 64 g/mol whereas A _S = 32 g/mol			975160
Number of inhabitants in 2008			3170048
Average amount of S per inhabitant / year 2008 in kg			0.154
Average amount of SO ₂ per inhabitant / year 2008 in kg			0.308



Results and Discussion ...

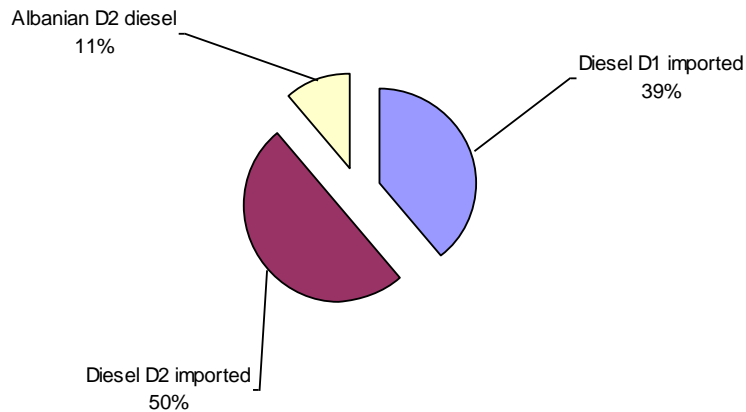


Figure 8: The mass percentage different types of Diesels traded in Albania in the year 2008. (Source: NICC, 2010).

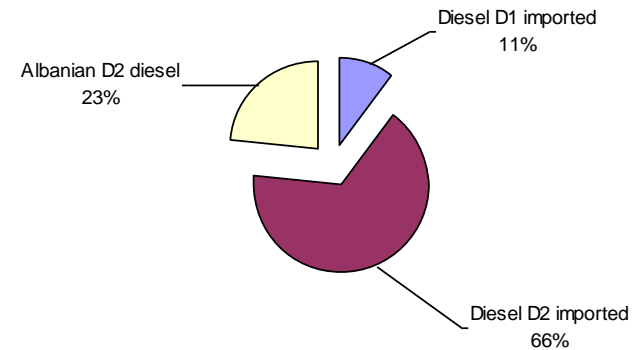
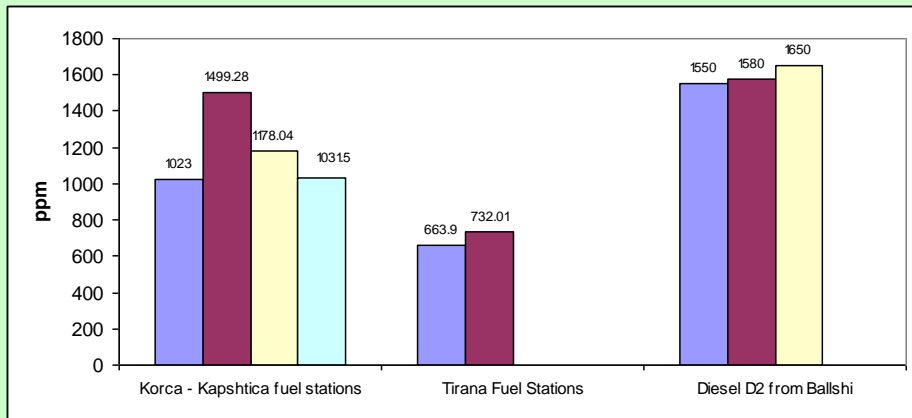


Figure 9: The mass percentage of the total amount of Sulfur contained in different types of Diesels traded in Albania in the year 2008.

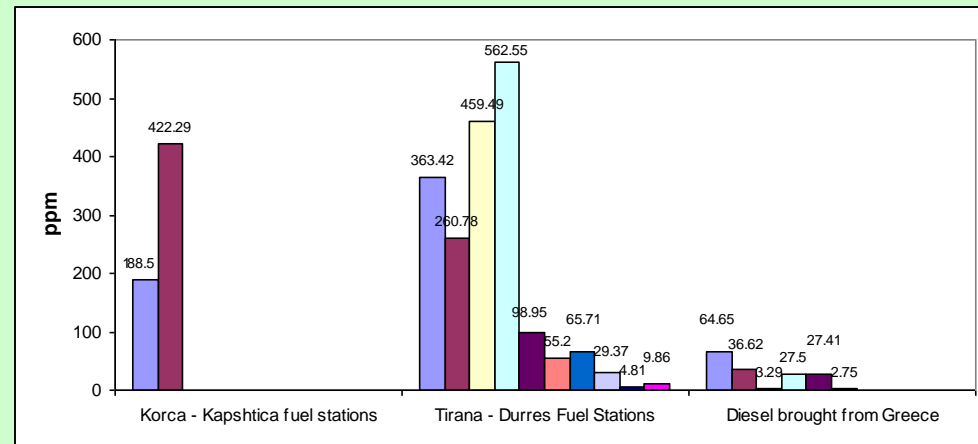
Results and Discussion ...

- From the graphs in Figure 8 and 9 it is easily noticeable that in the year 2008, although the Albanian D2 Diesel contributed with only 11 % of the total fuel quantity, due to its very high S content, it contributed with 23 % of the total S contained in the Diesels used, and consequently with 23 % of the total SO₂ released in the urban air, due to the Diesels combustion in vehicles' engines.
- On the other hand, the imported Diesel D1, or the EuroDiesel, contributed with 39 % of the total quantity of fuels, but only with 11 % of the total S in the fuels, and the 11 % of the total SO₂ released in the urban air due to its combustion.

Results and Discussion ...



• **Figure 10:** Sulfur content in Diesel D2 samples.



• **Figure 11:** Sulfur content in Diesel D1 samples.

Results and Discussion ...

- In this research it was found that the Diesels D2 used in Tirana District contained less S than the ones used in Korça District. As expected, and as it is illustrated in Figure 10, the samples of Diesel D2 from Ballshi Refinery contained much more S than all the samples of Diesel D2 imported in Albania.
- By comparing the S content in the Diesel samples taken in Albania with the ones taken in an EU country, Greece, it is noticeable that the average S content in Diesel D1 used in Albania is nearly 8 times more than the average S content in the Diesels used in Greece
- The variation of S content in the Diesel D1 samples taken in Albania is great, from 4.81 ppm to 562.55 ppm, whereas for the samples taken from Greece, the variation of S content is much smaller, from 2.75 to 64.65 ppm.

- By the Decision of the Council of Ministers No. 52 dt. 14 January 2009 (DCM, 2009) the Diesel produced in the Refinery of Ballshi would be allowed to be in the fuel market up to the end of 2009 and after that date the ARMO fuel company is obliged to produce and sell Diesel which will respect the EURO standards on this schedule:
- From 1 Jan. 2010, the Diesel not to contain more than 350 ppm S in it.
- From 1 Jan. 2011, the Diesel not to contain more than 150 ppm S in it.
- From 1 Jan. 2012, the Diesel not to contain more than 10 ppm S in it.

- By the percentage of the fuels consumed (Figures in slide 4), it is noticed that in the last seven years the quantity of Eurodiesel consumed in Albania has increased annually, comprising 74 % of the total quantity of the Diesel consumed in 2009, compared to the 18.5 % of the total quantity of Diesel consumed in 2003.

- This is a good indication of the pressure by the Government to the fuel importers to provide a good quality Diesel for the Albanian drivers, the majority of whom cannot afford to purchase a brand new car for themselves.

- Even in the D1 category of Diesel we do have fuel stations which provide Euro 5 Diesel with less than 10 ppm of sulfur in it, thus providing a market for the drivers who care not only about their cars but about their environment as well.

• CONCLUSIONS

- The Diesel samples analyzed were found to meet the Albanian Standard regarding the sulfur content, but in general they failed to meet the EU standards of Euro 5 type of Diesel. There were a few fuel stations that provided good quality Diesel comparable to the Diesel that was currently traded in Greece.

- Also the air quality in Tirana generally does respect the Albanian standard and the EU standard regarding the SO₂ concentrations in the 5 monitoring points, but the trends of these concentrations being increased annually in heavy traffic sections show that the respect of these standards will not last indefinitely.

- With the significant reduction of Diesel D2 consumption in 2009, there is noticed a slight decrease of the SO₂ air concentrations measured at the Tirana 4 station as the monitoring results of 2009 show.

• RECOMMENDATIONS

- **The Government needs to refresh the Standard regarding the sulfur content. At least, the import of only Euro 5 Diesel (with less than 10 ppm S) must be the first amendment of the Revised standard, in order to provide not only meeting for a very long time the SO₂ air concentrations standard, but also the SPM (Suspended Particulate Matter) and the PM₁₀ (particulate matter) standard.**

- In order to provide space for the native Diesel which has resulted always in very high S content, it is recommended that in the near future the Government finds the proper economical and legal mechanism that the private company that runs the Oil Refinery of Ballshi provides only Euro 5 Diesel for the Albanian car drivers and becomes a good competitor in the Diesel market in Albania.

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**THANK YOU VERY MUCH
FOR YOUR ATTENTION!**

Any Questions?