

TRENDS IN ATMOSPHERIC PARTICULATE MATTER AND GASES IN LEÓN (SPAIN): EFFECTS OF AIR QUALITY REGULATIONS

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Several studies have demonstrated that the exposure to high levels of air pollutants may cause a negative impact on human health and also may negatively affect the environment (Kampa & Castanas, 2008; Tang et al., 2005). For many years, in Europe some efforts have been made for diminishing the air pollutants emission. Thus, the *Directive 2008/50/EC* relative to *Ambient Air Quality and a Cleaner Atmosphere in Europe* was approved in 2008. In Spain, the legal basis relative to the *Air Quality and Atmosphere Protection and Improvement of Air Quality* is contained in the *Law 34/2007* and *Royal Decree 102/2011*, respectively. The study of the air pollutants trends is essential to show the evolution of emission sources over the years and to assess the effectiveness of emission control policies. In Spain, the studies show that the Spanish Government efforts for the reduction of the air pollutants emissions have achieved convincing results (Querol et al., 2014).

Data from four air quality stations (three traffic and one background stations), corresponding to the Castilla y León air quality network (www.jcyl.es), have been used, trying to establish the impact of the policies implemented by the European, Spanish and local Government in the last 19 years, concerning the reduction in the emission of air pollutants.

The calculations of trends were made with the ThielSen methodology that derives from the non-parametric Mann-Kendall test (Hipel & McLeod, 2005).

The trend shows, in general, a statistical significant decrease in the CO, NO, NO₂, SO₂, O₃ and PM₁₀ concentrations (up to -7.25, -6.04, -3.79, -8.54, -2.91 and -6.53 %/year, respectively, $p < 0.001$) in León city. This pattern has also been observed by the Spanish System of the Emissions Inventory (MAGRAMA), which reports a statistical significant decrease in the air pollutant concentrations mainly due to the reduction in the emissions from road traffic and public power in Spain between 1997 and 2014. Also, the change in the energy consumption and production in the province of León has had an important impact on this decreasing

trend. The Pearson coefficient in the traffic stations of León shows that there is a statistical significant correlation between PM₁₀ and NO ($R > 0.3$, $p < 0.01$) suggesting that both pollutants could have road traffic as a common source. Furthermore, a high correlation between PM₁₀ and CO ($R > 0.6$, $p < 0.01$) was observed, which reflects the relationship with the primary emissions from combustion process. In urban stations there is a significant correlation between PM₁₀ and SO₂ ($R > 0.4$, $p < 0.001$), indicating the contribution from combustion processes.

In León, there is a significant decrease in the atmospheric pollutant emissions as a consequence of several measures taken by the international, national and local government. The decrease in the air pollutant concentrations is evident since 2002. However, is from 2008 when the recorded values are within the allowed limit values, especially for PM₁₀ and SO₂ concentrations. The mainly sources of air pollutants in León are the road traffic and the combustion process (biomass and fossil fuels) in domestic heating systems.

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