



Methyl *tert*-butyl ether (MtBE) in deep wells of the Patiño Aquifer, Paraguay: A preliminary characterization

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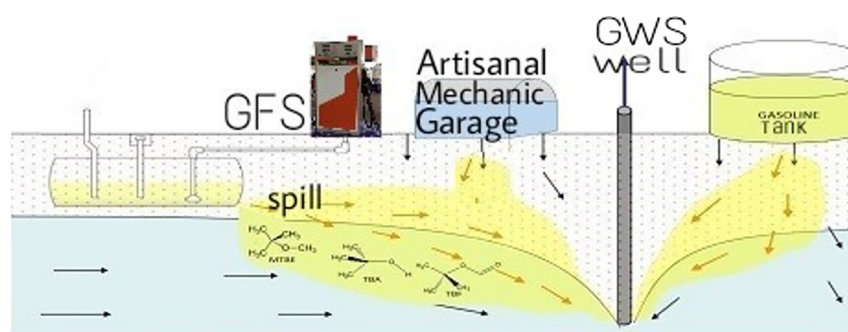
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HIGHLIGHTS

- Groundwater concentration of MTBE, TBA and TBF were estimated in urban and rural areas.
- Detectable concentration of MTBE are in areas of dense gasoline filling stations.
- Large potential contaminant sources were correlated with detectable concentrations of MTBE and by-products.
- MTBE and by-products were detected in high depths and at large distances from the potential source of pollution (<4000 m).

GRAPHICAL ABSTRACT



List of acronyms

BCP	Banco Central del Paraguay
DGEEC	Dirección General de Estadísticas, Encuestas y Censos
ERSSAN	Ente Regulador de Servicios Sanitarios
EPA	Environmental Protection Agency
GFS	Gasoline Filling Station
GWS	Groundwater System
MIC	Ministerio de Industria y Comercio
MOPC	Ministerio de Obras Públicas y Comunicaciones
SEAM	Secretaría del Ambiente
SENASA	Servicio Nacional de Saneamiento Ambiental

1. Introduction

Since 1979, oxygenates have been used in fossil fuels as an additive to improve combustion efficiency and, at the same time, reduce air

pollution. Methyl-*tert*-butyl ether (MTBE, $C_5H_{12}O$) is one of the most produced and widely used oxygenate in the world (Rosell et al., 2003). In 2014, the Minister of Industry and Commerce of Paraguay (ABC Color, 2014a, 2014b), reported MTBE concentrations from 16,6 to 18,5% by volumen found in gasoline, due to the lack of an official regulation. After an intense debate at the National Congress, the Ministry of Industry and Commerce regulated the concentration of MTBE in gasoline to up to 2% by volumen (MIC, 2013). Imports of MTBE reached a peak in 2013 when 6.2 Ton was imported, however, at the end of 2015, the imports went drastically down to just 15 kg (BCP, 2018). MTBE was developed in the 70s as an octane enhancer in fuels as lead, and it was gradually substituted in gasoline due to its toxicity. The oxygenates promote cleaner fuel combustion, increase octane values, and reduce air emissions. The MTBE has high-octane properties, is cost-effective, and supplies flexibility, thus it is the most used oxygenate (Rosell et al., 2007; Davis and Farland, 2001).

On the other hand, MTBE may represent a health hazard since it is easily absorbed by the human body orally, by inhalation and through the skin. After absorption, a fraction of the MTBE is exhaled without alteration. However, the other fraction is oxidized to *tert*-Butyl alcohol (TBA) and formaldehyde, a genotoxic chemical and known human carcinogen in the Cytochrome P-450 complex (Brady et al., 1990). The results

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