

# DETECTION OF ORGANOPHOSPHORUS ESTERS (OPEs) IN GROUNDWATER

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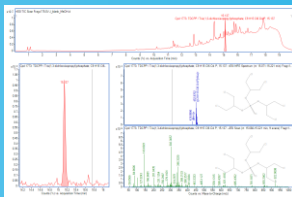
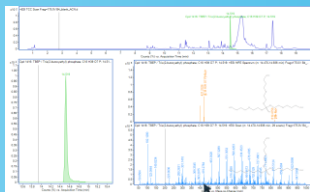
## INTRODUCTION

Emerging pollutants, in particular organic pollutants in groundwater are not enough researched due to the absence of monitoring regulations, nevertheless, monitoring is on a voluntary base.

Organophosphate esters (OPEs), triesters, are high-production volume chemicals with large variations in physical-chemical properties widely used in many human activities and can be detected in groundwater due to their insolubility in water, especially in wastewater.

## EXPERIMENTAL PART

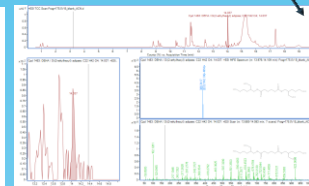
Sampling of groundwater is carried out from three piezometer wells on Bokanjac – Poličnik basin near city of Zadar in Croatia. Samples were taken four times in one year in order to have all seasons covered. Sterile glass bottles was used, and they were refrigerated through transport and until sample preparation began. Prepared analyte is concentrated through Solid Phase Extraction (SPE) method just to increase selectivity of the method. Cartridges used for SPE are Bond elut plexa C18 and the samples was eluted with methanol (MeOH) and filtered through KX syringe filter PET 25 mm, 0,22. Filtered samples are analyzed in Agilent 6530 LC/MS QToF device that detects ion masses (M/z) and relative abundance of isotopes. LC/MS QToF analysis was performed with a InfinityLab Poroshell 120 EC – C18 (3,0 x 100 mm), 2,7 μm, Agilent Technologies, Inc. column. Injecting 0,4 mL/min of an-alyte with mobile phases: (A) deionized water with 0,1 % formic acid, (B) MeOH with 0,1 % formic acid, (C) acetonitrile (ACN) with 0,1 % formic acid. These mobile phases were used in 20 min run in positive ionization mode and with column temperature of 35 °C.



OPEs	CAS no.	Formula	Usage
TBEP	78-51-3	C <sub>24</sub> H <sub>51</sub> O <sub>4</sub> P	Adhesives, sealant chemicals, Flame retardants, Paint and coating additives, Plasticizers, Cleaning-furnishing care products
TCP	78-32-0	C <sub>21</sub> H <sub>21</sub> O <sub>4</sub> P	Plasticizer, flame-retardant, solvent for nitrocellulose, as additive to extreme pressure lubricants, fluid in hydraulic systems, as lead scavenger in gasoline, to sterilize certain surgical instruments, In flexible PVC.
TPPA	115-86-6	C <sub>18</sub> H <sub>15</sub> O <sub>4</sub> P	Flame retardants, Paint and coating additives, Plasticizer in automobile upholstery, fireproofing agent, for impregnating roofing paper, component of lubricating oil and hydraulic fluids.
TCPP	13674-84-5	C <sub>9</sub> H <sub>18</sub> Cl <sub>3</sub> O <sub>4</sub> P	Adhesives and sealants, Building/construction materials - wood products, Electrical and electronic products, Fabric, textile, and leather products, Flame retardant, Foam seating and bedding products, Insulating foam, Plastic, and rubber products
TCEP	115-96-8	C <sub>6</sub> H <sub>12</sub> Cl <sub>3</sub> O <sub>4</sub> P	Additive plasticizer and flame retardant in plastics, especially in flexible foams used in automobiles and furniture, and in rigid foams used for building insulation.
TDCPP	13674-87-8	C <sub>9</sub> H <sub>15</sub> Cl <sub>3</sub> O <sub>4</sub> P	Flame retardant, Plasticizer, used in polyvinyl chloride, rigid PUF, epoxy resin, and polyester fiber.
DEP	84-66-2	C <sub>12</sub> H <sub>14</sub> O <sub>4</sub>	Adhesives and sealants, Air care products, Automotive care products, Cleaning and furnishing care products, laundry and dishwashing products, Personal care products, toys, playground, and sporting equipment, aroma chemicals
TBP	126-73-8	C <sub>12</sub> H <sub>27</sub> O <sub>4</sub> P	Flame retardants, Functional fluids (closed and open systems), Plasticizer, Building/construction materials, Hydraulic Fluid, Ink, toner, and colorant products
DEHA	103-23-1	C <sub>22</sub> H <sub>42</sub> O <sub>4</sub>	Bis(2-ethylhexyl) adipate is a diester. It is used as a plasticizer in the preparation of various polymers. Adhesives and sealants, Automotive care products, Building/construction materials, Electrical and electronic products, Fabric, textile, and leather products. Food packaging, Fuels and related products, Furniture and furnishings, Lubricants and greases, Metal products, Paints and coatings, Personal care products

## CONCLUSION

OPEs are potential pollutants in groundwaters that are not under regulations and there are no defined maximum available concentrations for such emerging pollutant. Nine of the OPEs was detected in groundwater samples in one karst basin in Croatia through all seasons of one year. Consequently, there is a need for raising the public awareness of usage and release of OPEs in the environment.



Also, some of OPEs are dangerous for human health. That's why research on their identification, quantification and behavior in groundwater is important.

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