LANCASTER UNIVERSITY

AQUATIC FATE TESTING OF DIAZINON AND ITS DEGRADATE USING LC/ESI/MS/MS

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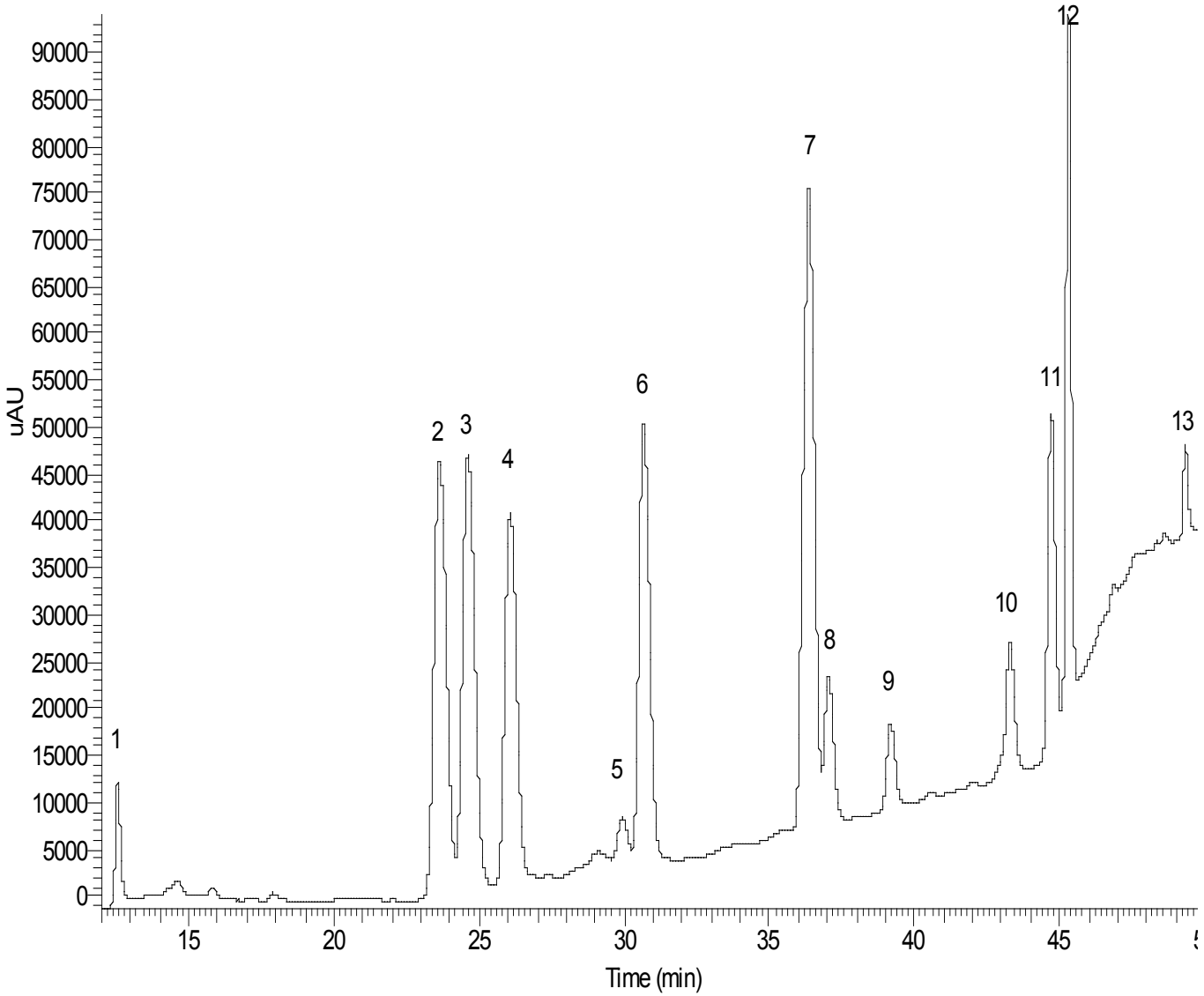
ORGANOPHOSPHORUS PESTICIDES

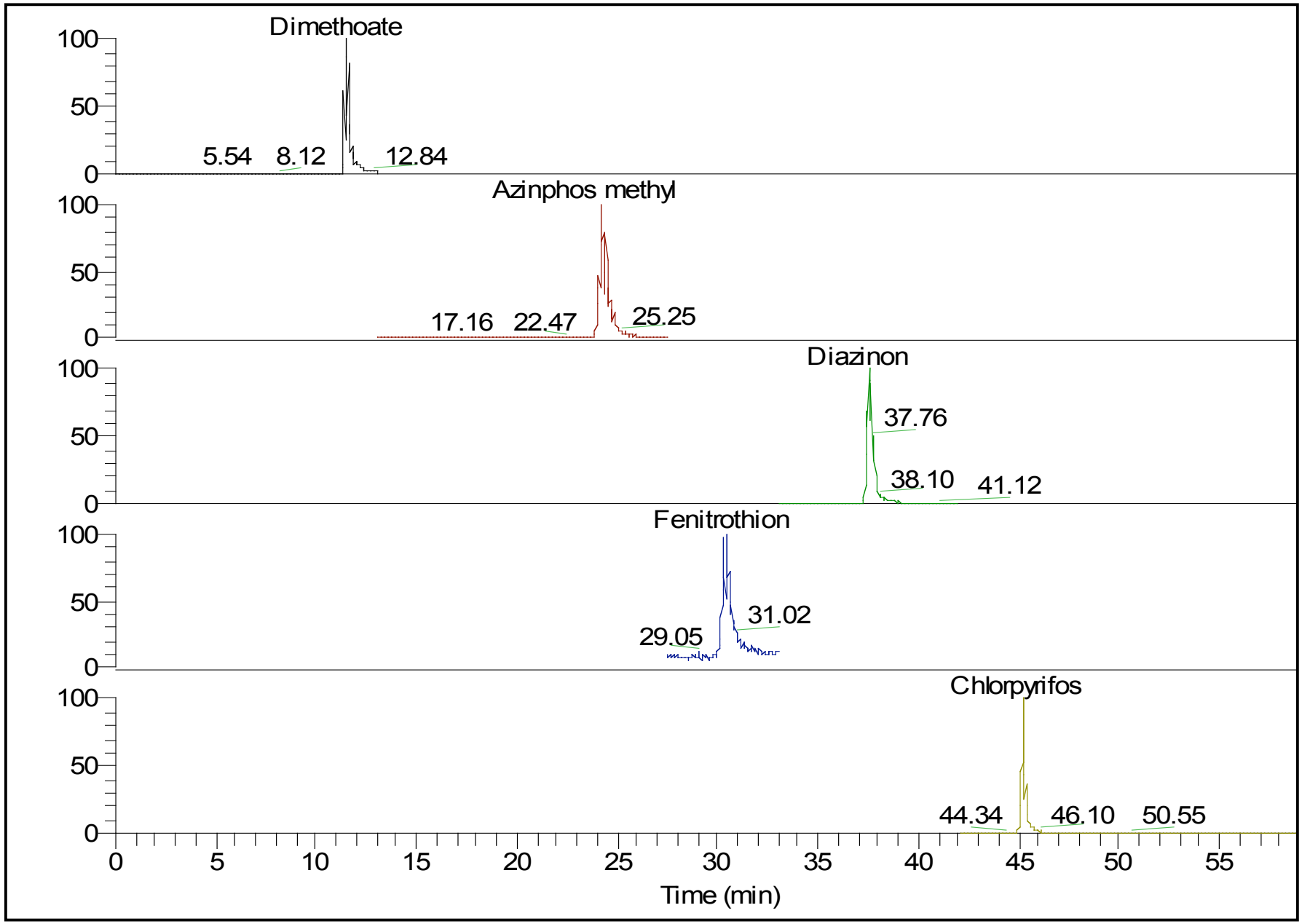
- Organophosphorus pesticides have been used in place of the more persistent organochlorine pesticides

- Acetylcholinesterase inhibitor
- Occur in priority pollutants lists e.g. EU Water Framework Directive (WFD)

- Analytical tools for the determination of OP pesticides
  - GC (NPD, ECD, FID)
  - GC- MS
  - HPLC
  - LCMS



Chromatogram showing the separation of the pesticides mixtures into their individual components **1 = Dimethoate, 2 = Azinphos methyl, 3 = Imidan, 4 = Methyl Parathion, 5 = Malathion, 6 = Fenitrothion, 7 = Fenthion, 8 = Diazinon, 9 = Fonofos, 10 = Disulfoton, 11 = Terbufos, 12 = Temephos, 13 = Chlorpyrifos (Ukpebor et al)**



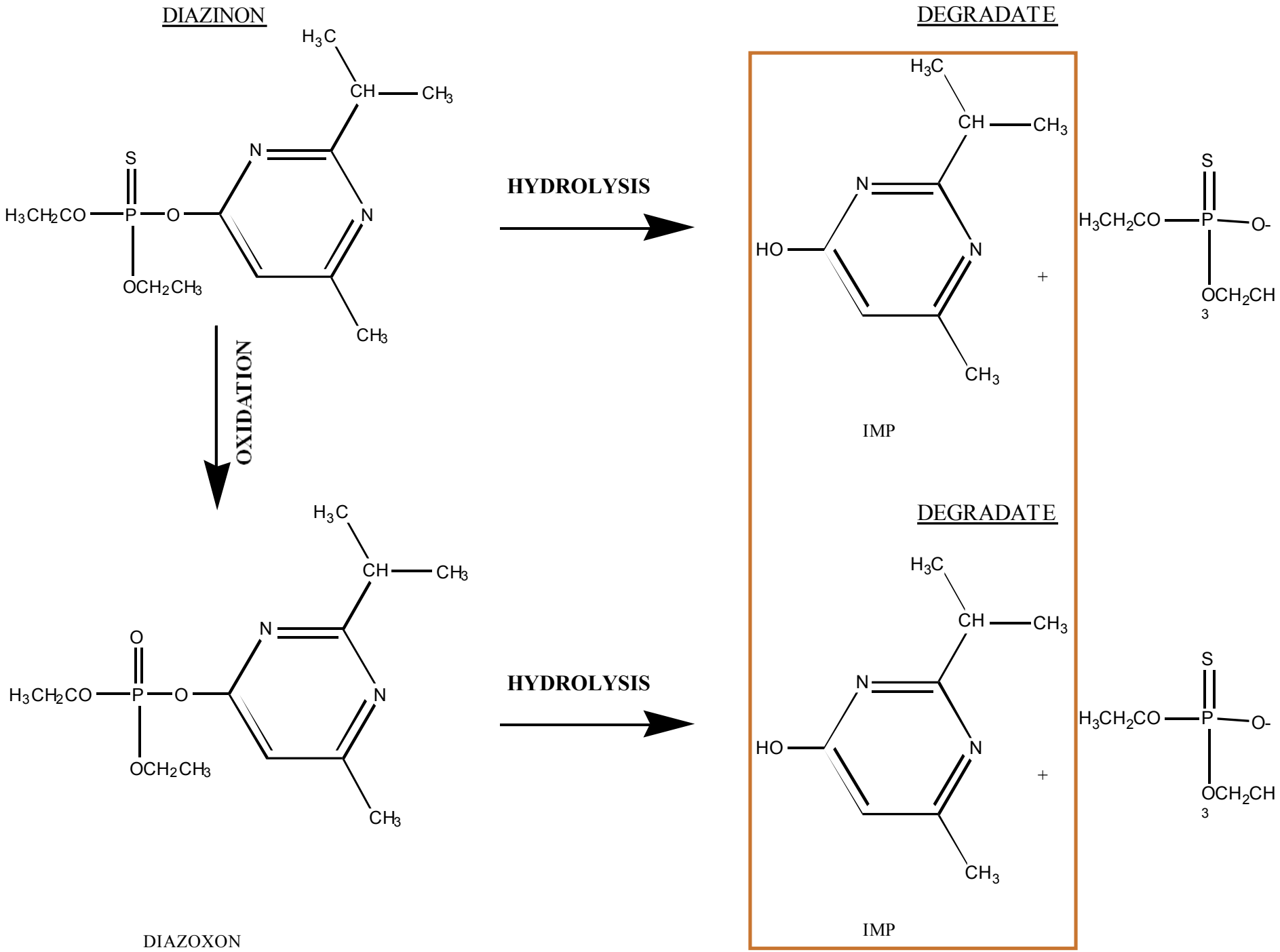
Mass spectra for some of the selected OP pesticides

DIAZINON

- Finds most application as an active ingredient in sheep dip – therefore has the potential to contaminate upland/remote catchment waters
- Due to its low absorption in the UV region, it cannot undergo direct photochemical degradation

- How persistent is this chemical?
- What conditions promote abiotic degradation?
- What are the degradates and are they toxic?

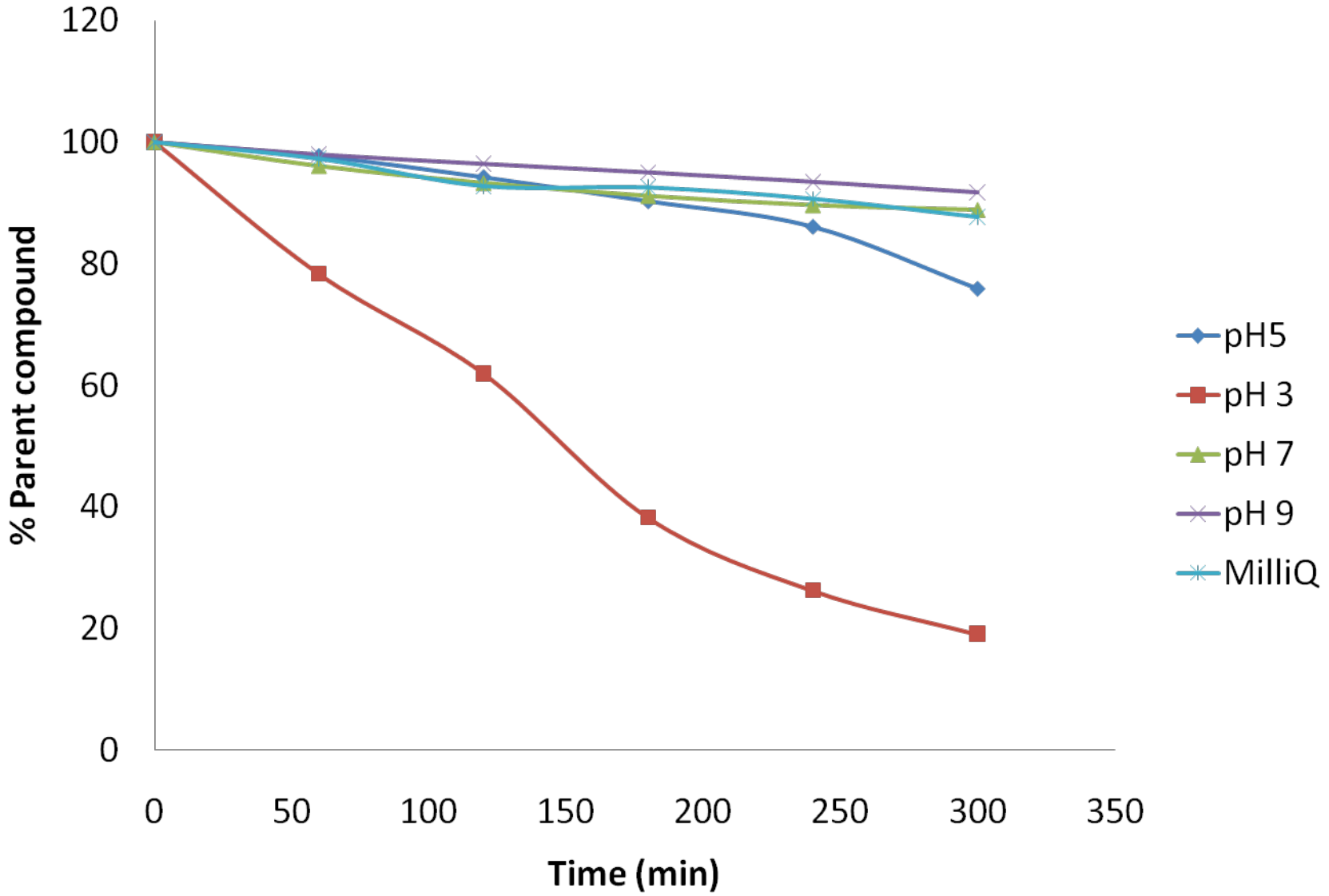
Source: www.rsc.org/images/NEWS-p8-sheep-dipping-250


DIAZINON
DEGRADATE
HYDROLYSIS
OXIDATION
IMP
DEGRADATE
HYDROLYSIS
IMP
DIAZOXON

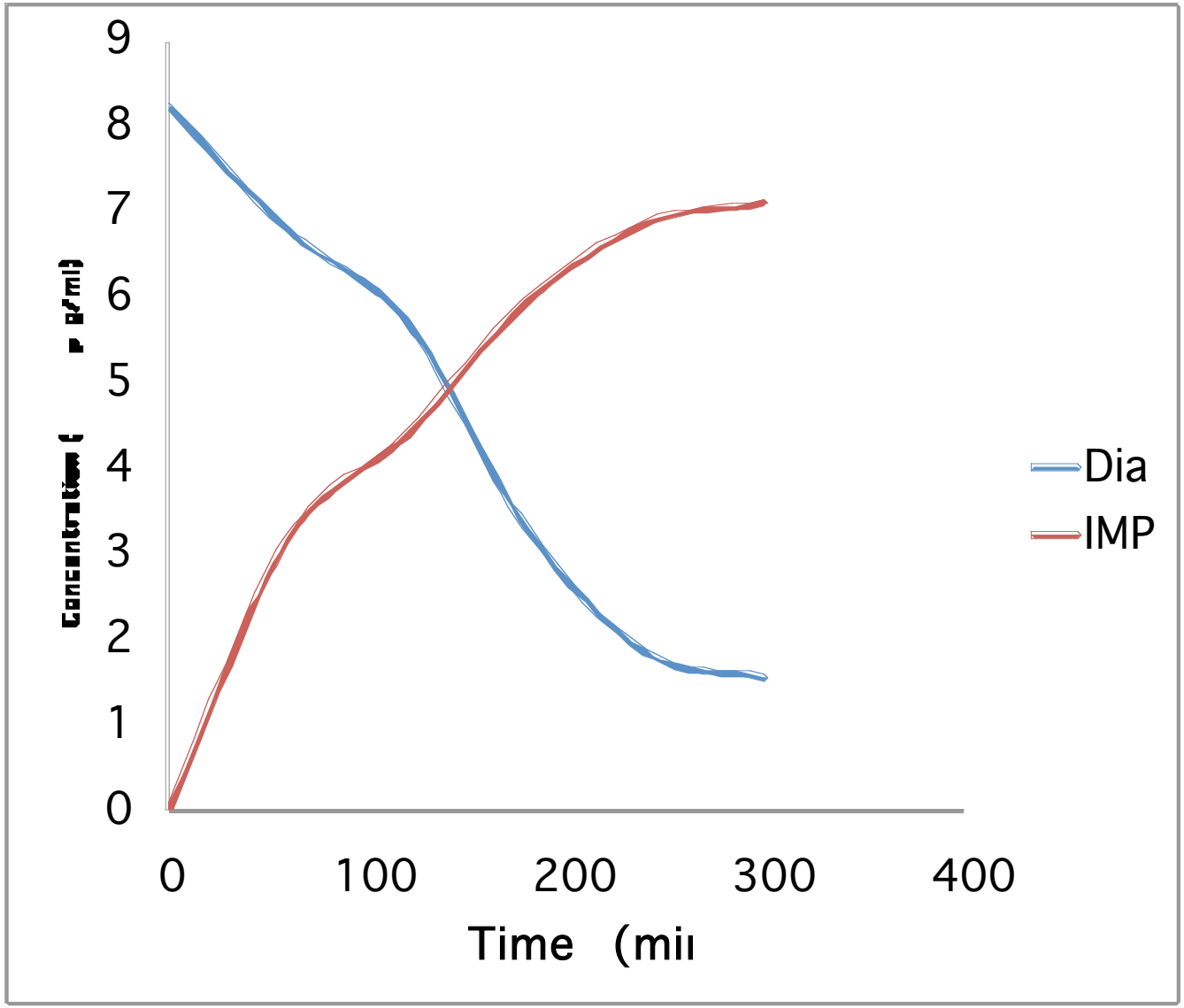
Experimental

- Solutions of Diazinon and IMP ~9 μg/ml were prepared in different buffered solution
- pH buffers – 3, 5, 7 and 9
- Samples were stored in 100 ml amber vials and placed in a thermostated water bath.
- Triplicate samples (1 ml) were taken periodically and analyzed using LCMS

Preliminary Results:



Hydrolysis of Diazinon in different solutions



Hydrolysis of Diazinon and formation of IMP at pH3

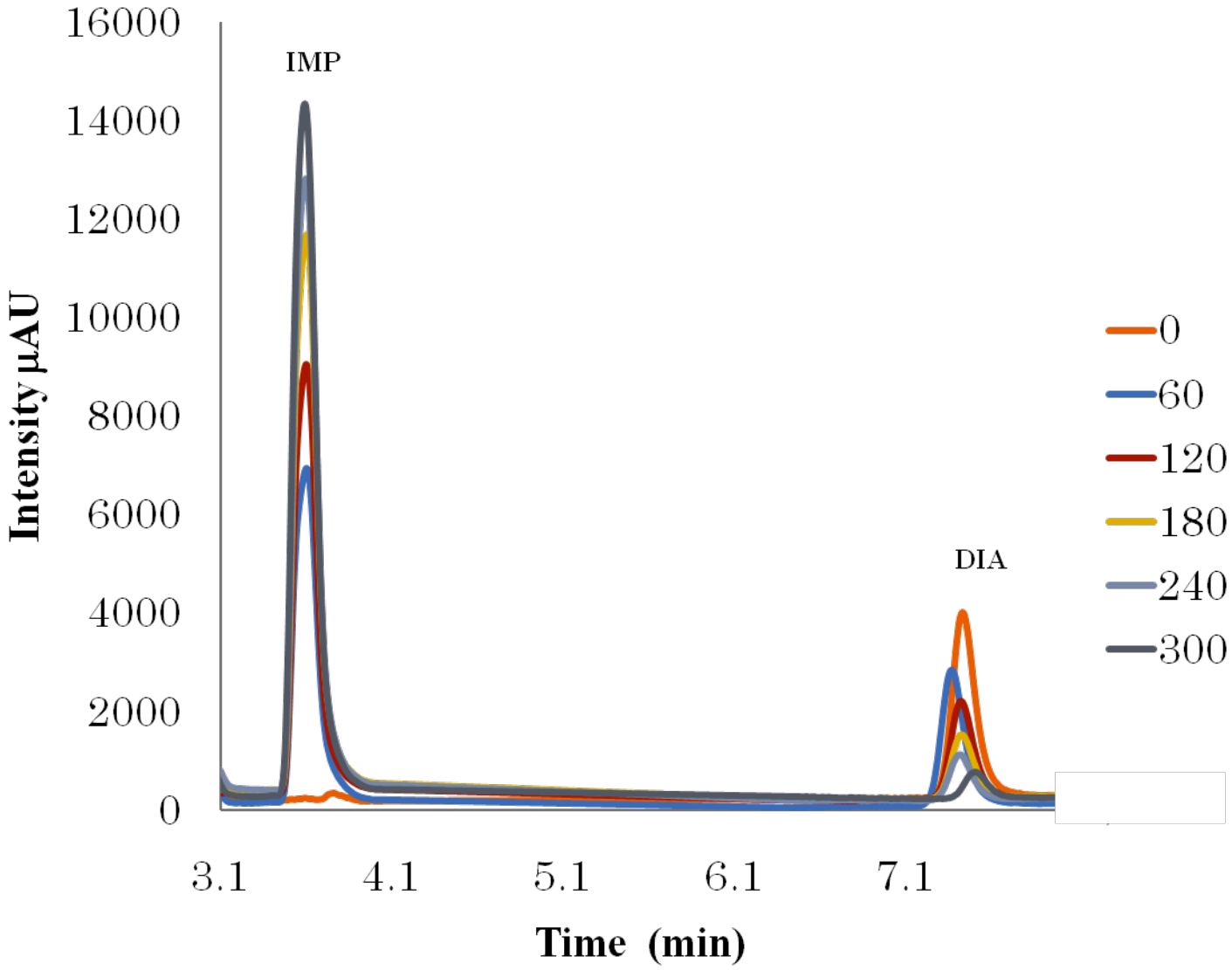
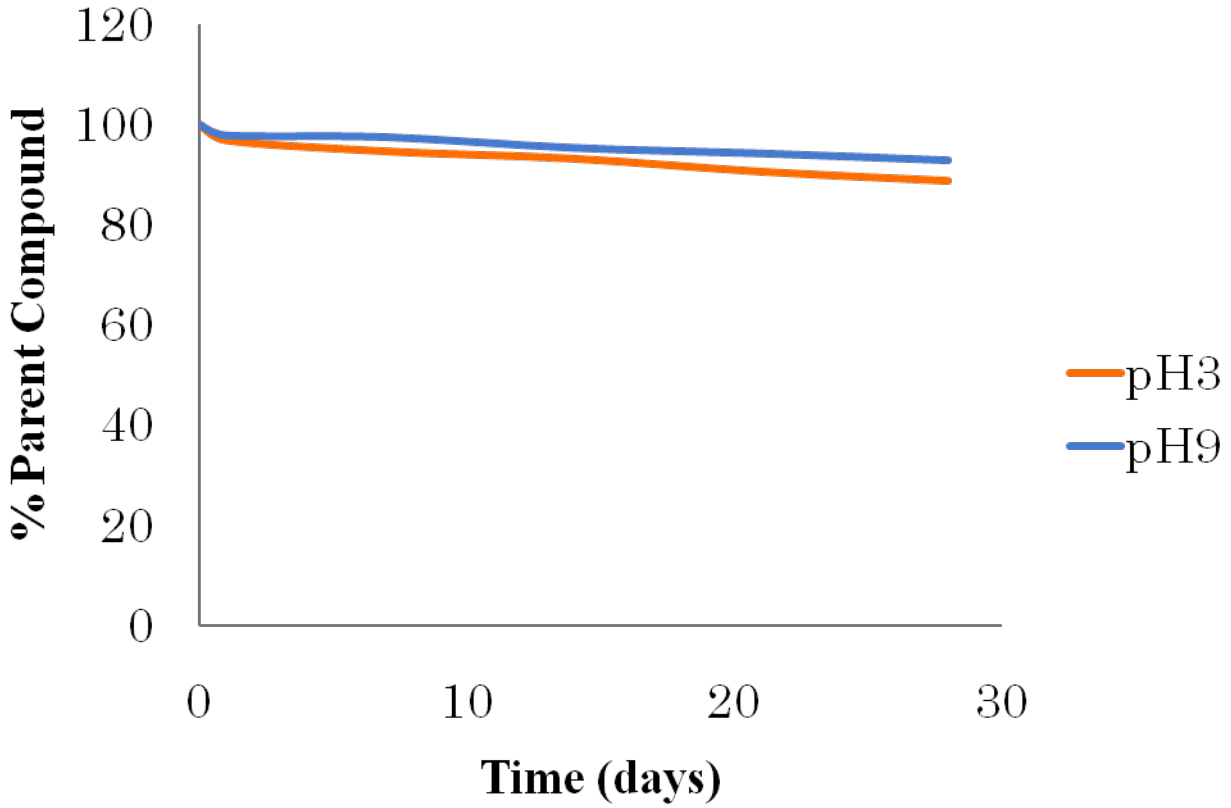


Figure showing LC – DAD hydrolysis of Diazinon and IMP formation



Hydrolysis of IMP at pHs 3 and 9

FINDINGS

- Diazinon is relatively stable to hydrolysis at near neutral pHs – typical of surface waters in NW England.
- Half life of diazinon at pH 3 and 7 is ~2.03hours and ~2380hours respectively.
- IMP is the major degradate formed at lower pHs. Over time, IMP is likely to be present downstream of sheep dip areas.
- Modifying "used" sheep dip solution to pH 3 or 4 before disposal, would be a simple, cheap and effective way of removing diazinon residues and reducing stream/river contamination

FUTURE RESEARCH

- ✓ Indirect photochemical/Photosensitized degradation studies of diazinon and IMP using Solar Atlas Simulator
- ✓ Toxicity tests for diazinon and its degradate IMP
- ✓ Field testing for laboratory simulated hydrolysis tests
- ✓ Photodegradation of OP pesticides on plants surfaces and under plastic films

Thank you