Scale-up of a photocatalytic reactor for the degradation of pesticides at source

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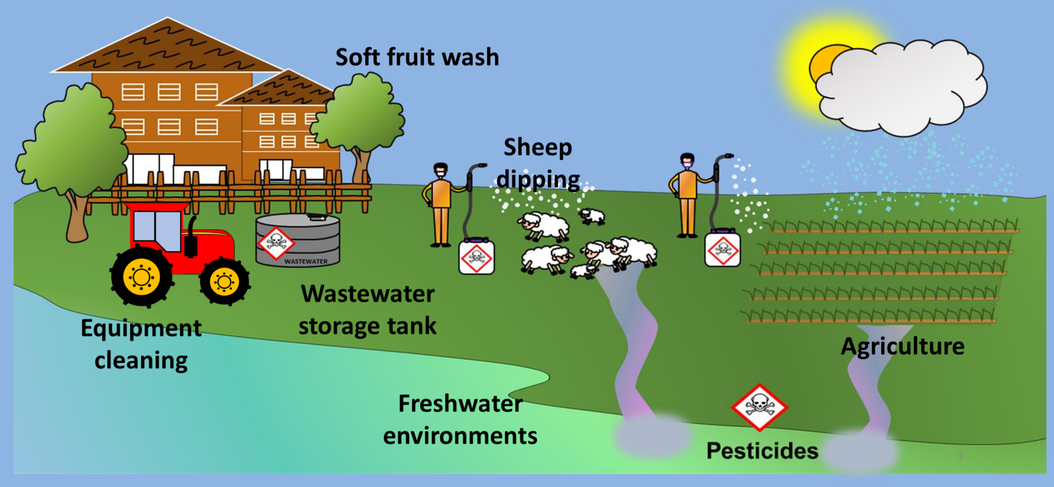
Introduction

Pesticides find their way into natural environments due to rainfall runoff, agricultural activities and incomplete removal by conventional treatments.

Photocatalysis can be applied for the removal of pesticides – a catalyst needs to be illuminated by light of sufficiently high energy which will ultimately produce radicals with high oxidative power.

Graphitic carbon nitride (g-C_3N_4) coated beads and UV-A light emitting diodes (LEDs) photocatalysis can be used as an economical alternative technology for pesticide removal.

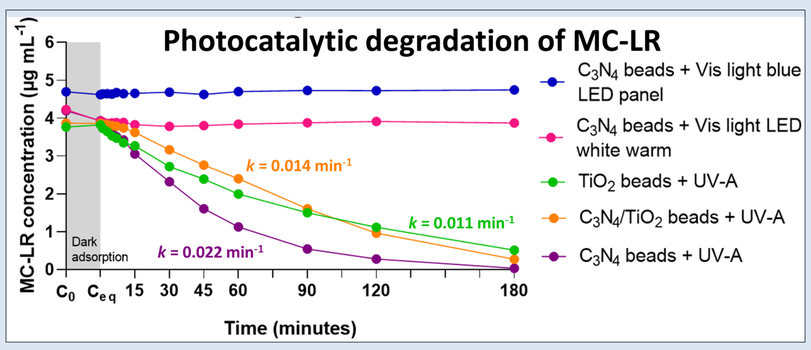
It is necessary to develop an economical and safe alternative that can be applied at source to remove pesticides prior to the treatment plant or before discharge into the environment.



Pesticides in the environment

Catalyst and light source selection

1



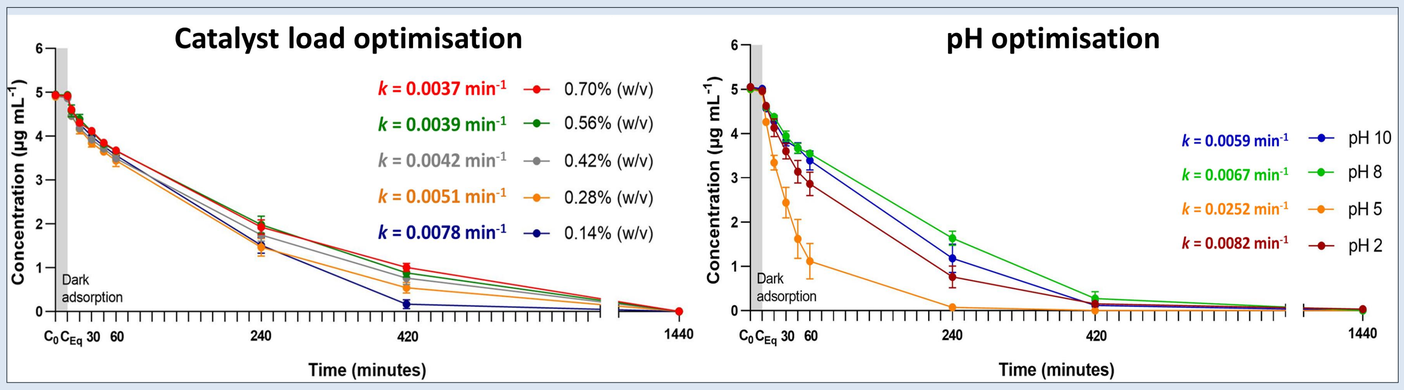
TiO_2 and g-C_3N_4 coated beads

Beads made with recycled glass were coated with different catalyst. TiO_2 and g-C_3N_4 coated beads and different light sources (UV-A and visible light) were evaluated for best photocatalytic performance.

Photocatalytic system optimisation

2

Optimal initial solution pH and catalyst load were determined to better understand the optimal conditions for the photocatalytic system.
The herbicide diuron was used as a model compound.

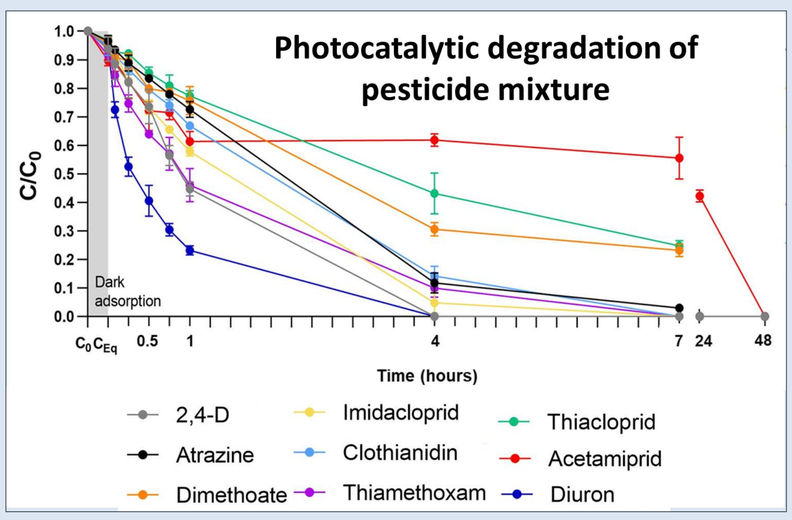


Photocatalytic degradation of diuron by UV-A LEDs and and g-C_3N_4 coated beads

Bench-scale pesticide degradation

3

UV-A LEDs and g-C_3N_4 coated beads were successful on the removal of pesticides. All pesticides tested were completely removed within 48 hours. Degradation products might have contributed to acetamiprid concentration.



Reactor scale-up

4

Non-waterproof UV-A LED

Two-part resin

Waterproof LED tubing

Reactor prototype

Treatment unit implementation

5 **Future work**

- Design, test and optimise prototype reactor incorporating UV-A LEDs and g-C_3N_4 coated beads
- Deploy and evaluate photocatalytic reactors in selected farms across Scotland
- Potential application in Scottish salmon farms

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