

Efficient Degradation of Fluorinated Pesticides in Water Using Electrochemical Oxidation with

Boron Diamond Electrodes

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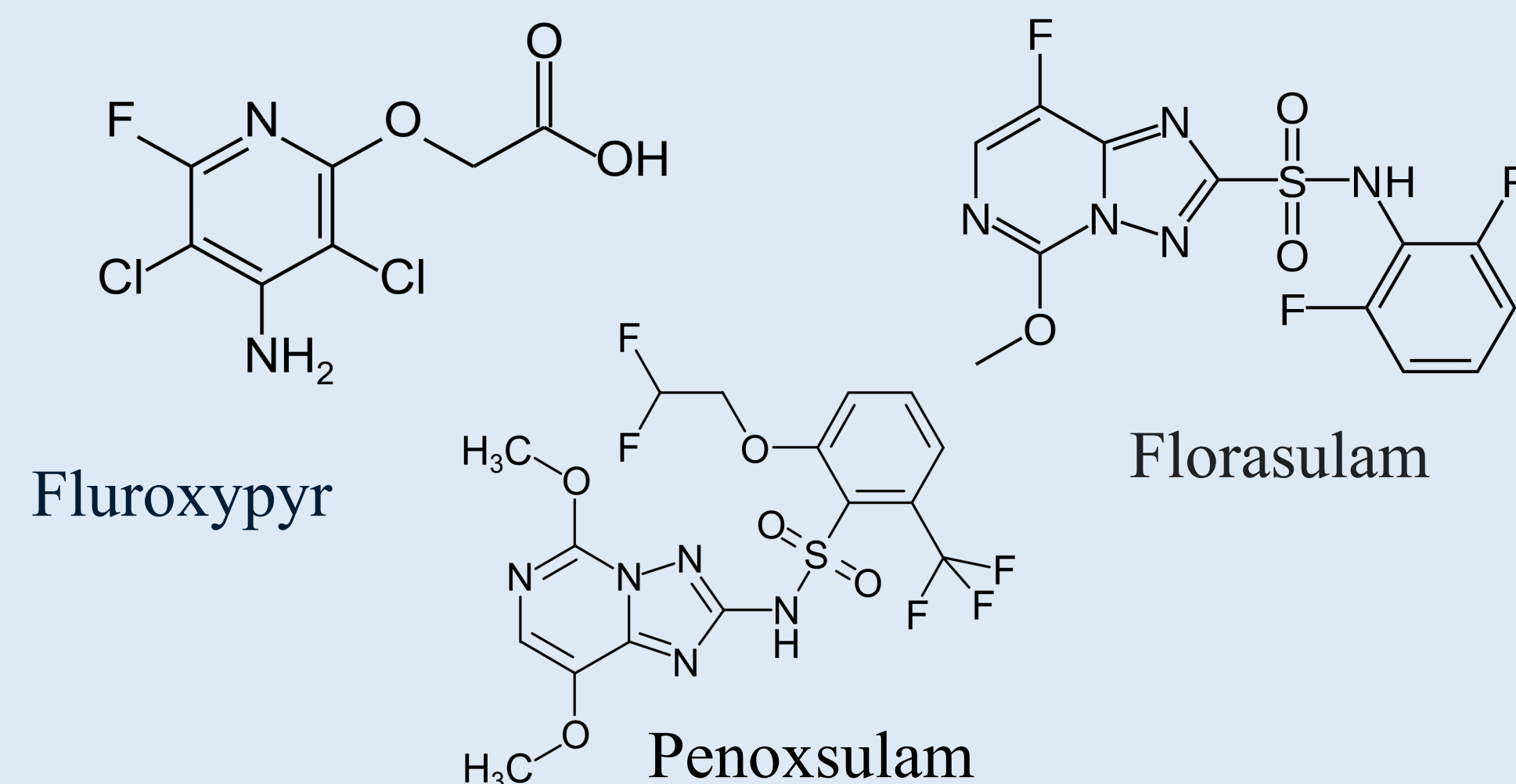
BACKGROUND

Pesticide use in agriculture has led to increased crop production but has also contaminated surface water, posing a threat to drinking water quality. Emerging fluorinated pesticides, known for their effectiveness, have been detected in drinking water sources. Electrochemical oxidation (EO) using boron diamond electrodes has shown promise in degrading organic compounds in water, but its effectiveness against fluorinated pesticides, which feature resilient carbon-fluoride bonds, remains uncertain.

RESEARCH OBJECTIVES

1. Examine the degradation kinetics of fluorinated pesticides through EO in water
2. Assess the influence of diverse operating conditions on fluorinated pesticides degradation efficiency by EO

EXPERIMENTAL PROCEDURE



EO System

- Parallel plates boron doped diamond electrodes
- 218 cm² electrode surface area
- Continuous flow reactor
- 2 L solution volume

Solution

- Fluorinated pesticides concentrations 10 ppm each (unless otherwise stated)
- Electrolyte used: sodium sulfate
- Deionized water, ground water, landfill leachate

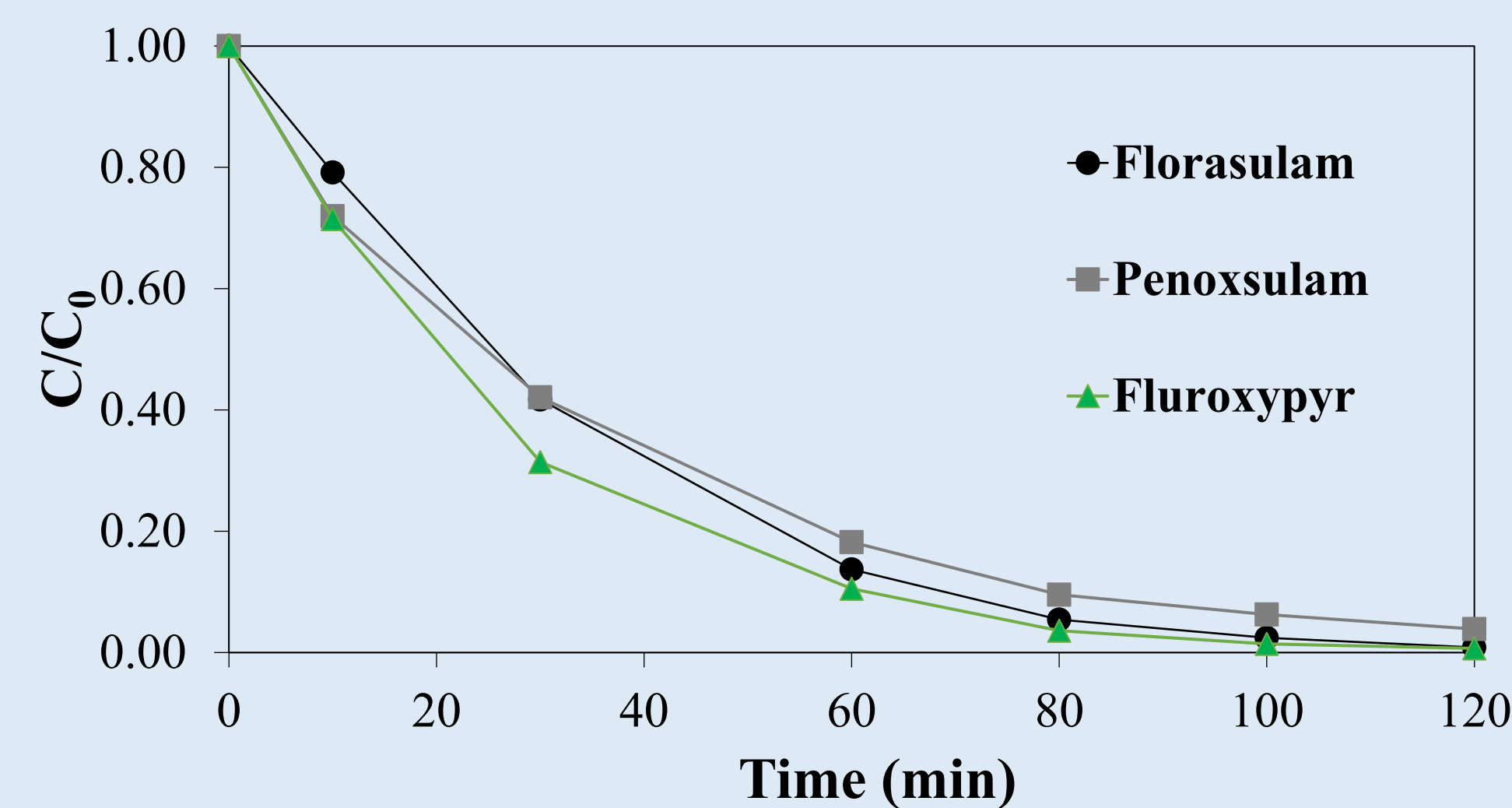
Parameters

- Current density: 10 - 50 mA/cm²
- Electrolyte concentration: 10 - 100 mM
- Flow rate: 2 - 8 L/min
- Pesticide concentration: 2.5 - 10 ppm
- Experimental duration: 2 hrs.

Concentrations of fluorinated pesticides were analyzed using liquid chromatography mass spectrometry (LC-MS/MS).

RESULTS

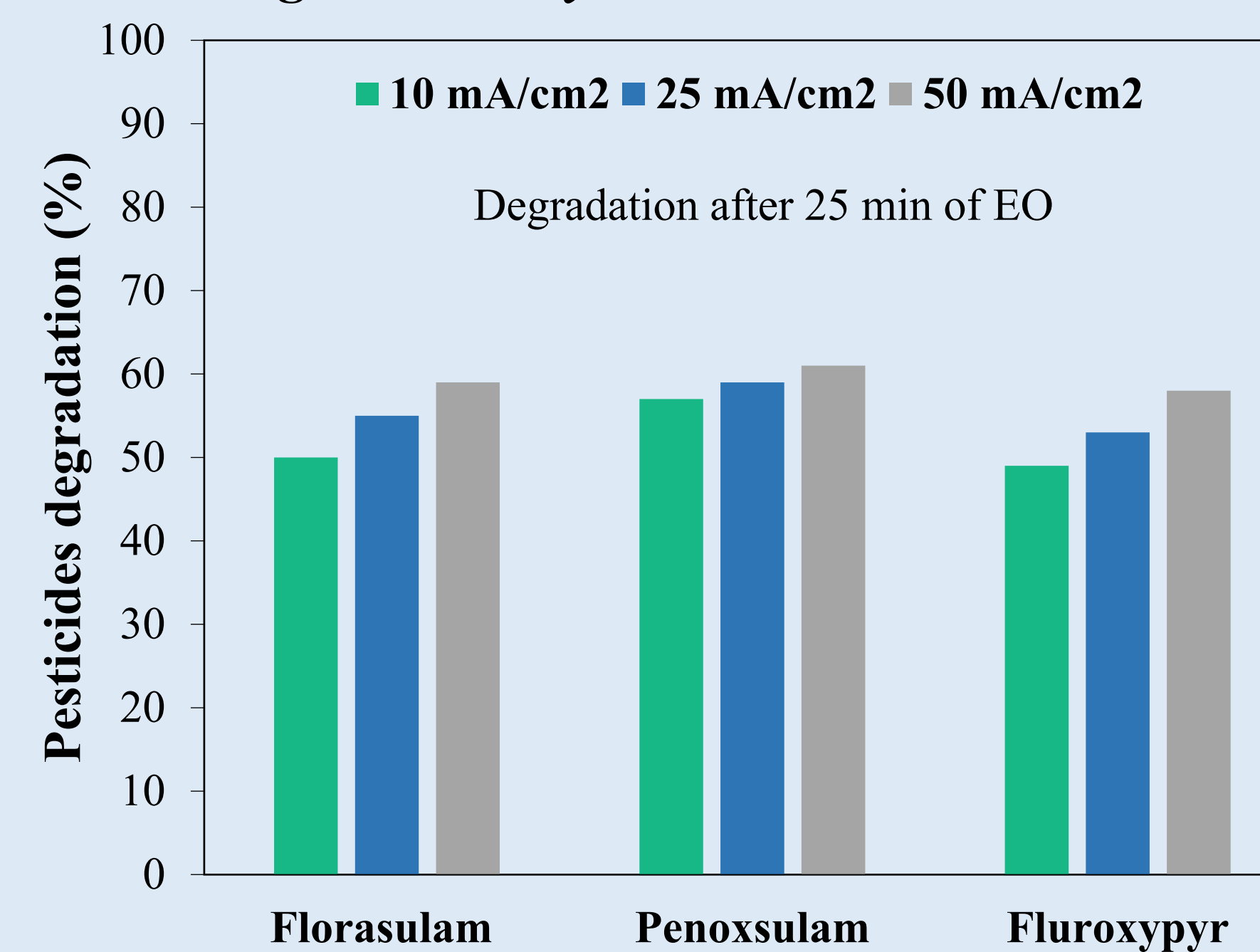
Test 1: Degradation of fluorinated pesticides in water by EO



Experimental conditions: current density = 50 mA/cm², sodium sulfate = 10 mM, flow rate = 8 L/min in deionized water

Conclusion: Rapid degradation of the three pesticides were observed with more than 90% observed in 60 min for all pesticides

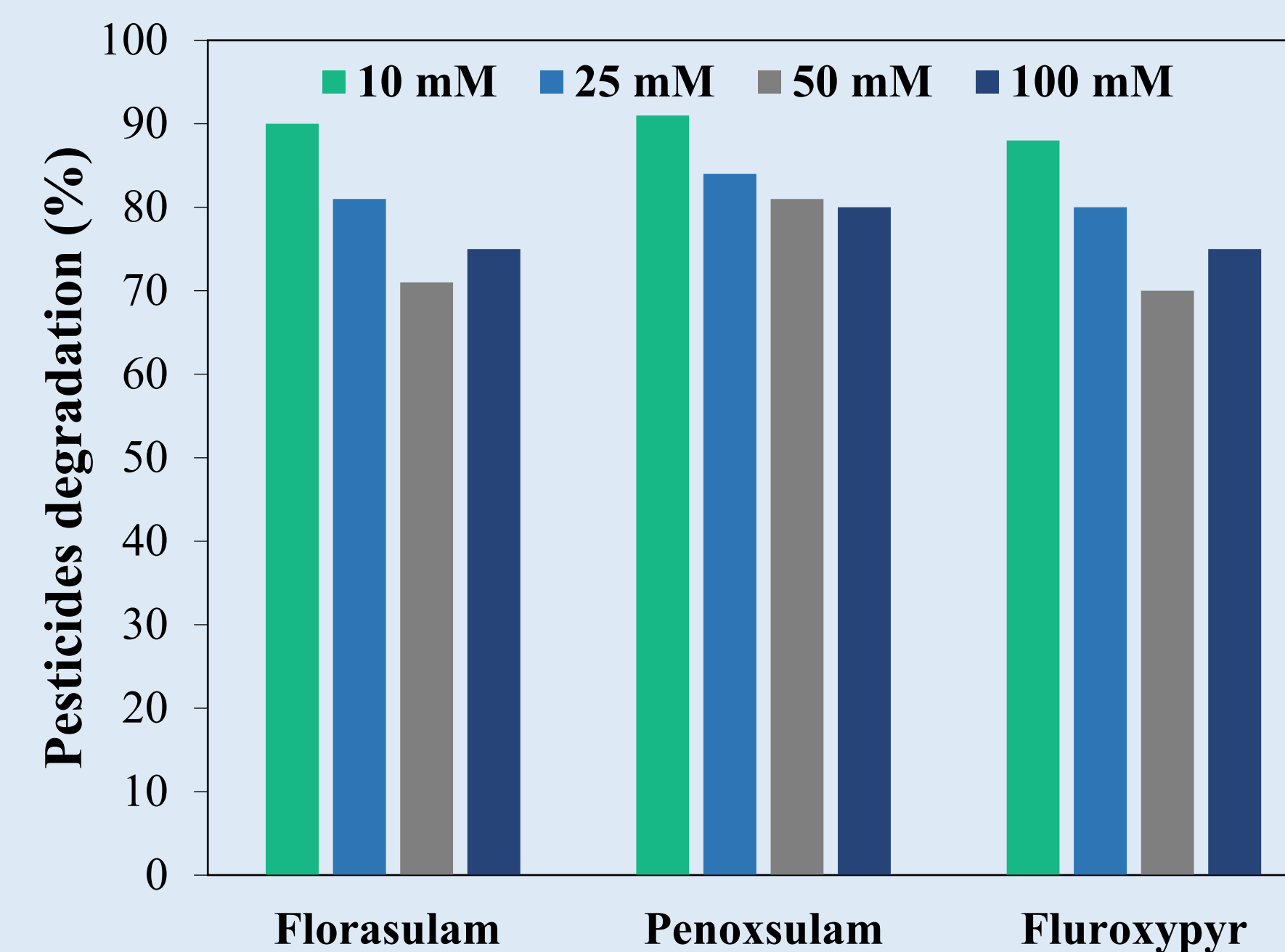
Test 2: Impact of variable current densities on fluorinated pesticides degradation by EO



Experimental conditions: sodium sulfate = 10 mM, flow rate = 8 L/min in deionized water, experimental duration = 25 min

Conclusion: Increasing current density to 50 mA/cm² led to a 10% higher pesticide degradation compared to 10 mA/cm².

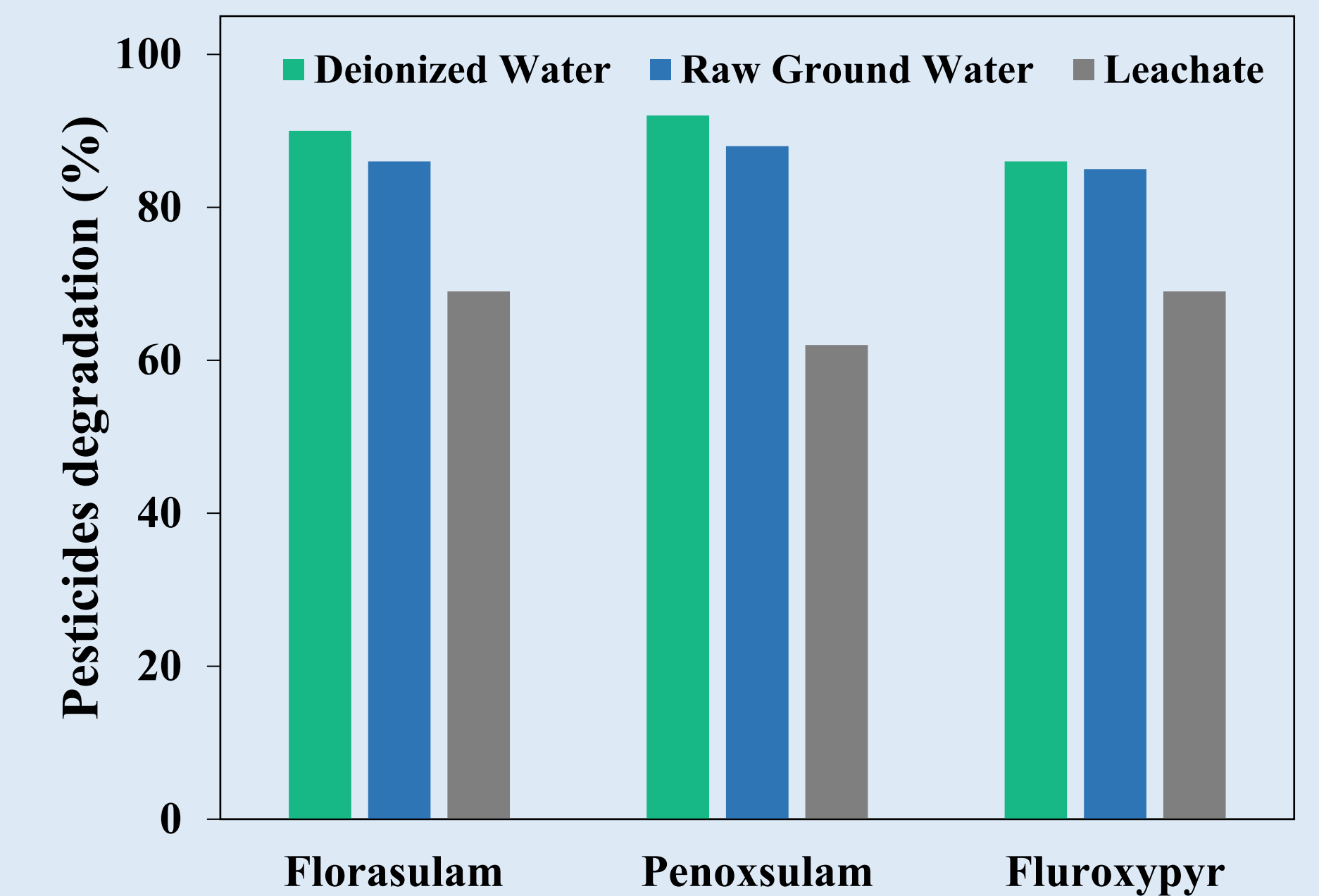
Test 3: Impact of sodium sulfate concentration on fluorinated pesticides degradation by EO



Experimental conditions: current density = 50 mA/cm², flow rate = 8 L/min in deionized water, experimental duration = 60 min

Conclusion: Lower concentration of sodium sulfate increase fluorinated pesticides degradation by EO

Task 4: Impact of water matrix on fluorinated pesticides degradation by EO



Experimental conditions: sodium sulfate = 10 mM, flow rate = 8 L/min, experimental duration = 60 min

Conclusion: EO showed lower efficacy in degrading fluorinated pesticides in leachate compared to groundwater or distilled water.

CONCLUSIONS

1. EO is very effective in rapid degradation of fluorinated pesticides in water

Table 1: The experimental half-life of pesticide with EO (conditions: current density = 50 mA/cm², sodium sulfate = 10 mM, flowrate = 8 L/min)

Pesticide	Fluroxypyr	Penoxsulam	Florasulam
Half Life (min)	16.5 ± 0.5	25.1 ± 0.3	17.5 ± 0.7

2. Generated hydroxyl radical (HO•) might be responsible on fluorinated pesticides degradation by EO in water
3. Increase in applied current densities, lead to moderate increase in pesticides degradation by EO
4. High concentration of sodium sulfate (> 10 mM) interfere with EO process, by quenching HO•
5. Highly contaminated waters, hinder EO degradation by quenching HO• and contaminating EO electrode surfaces.
6. Altering flow rates and pesticide concentrations showed no discernible impact on pesticide degradation via EO.

ACKNOWLEDGMENTS

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