



**University of
Nottingham**

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Advanced electrochemical oxidation of antibiotics in dairy slurry

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Antimicrobial resistance (AMR)

EUROPE



25,000

people die each year

as a result of hospital infections caused by

**5 key
resistant
bacteria**



GLOBAL

**A failure to address the problem of
antibiotic resistance could result in:**



**10m
deaths
by 2050**

**Costing
£66
trillion**

CAUSES OF ANTIBIOTIC RESISTANCE



Antibiotic resistance happens when bacteria change and become resistant to the antibiotics used to treat the infections they cause.



Over-prescribing
of antibiotics



Patients not finishing
their treatment



Over-use of antibiotics in
livestock and fish farming



Poor infection control
in hospitals and clinics



Lack of hygiene and poor
sanitation



Lack of new antibiotics
being developed

www.who.int/drugresistance

#AntibioticResistance

Antimicrobial resistance

It has been estimated that the use of antibiotics in agriculture accounts for over **75% of annual antimicrobial consumption** in the **EU** and the **US**.







European Union Strategic Approach to Pharmaceuticals in the Environment [COM(2019) 128 final]

“cost-effective methods for reducing concentrations of pharmaceuticals including antimicrobials in slurry, manure and sewage sludge to enable their use in the circular



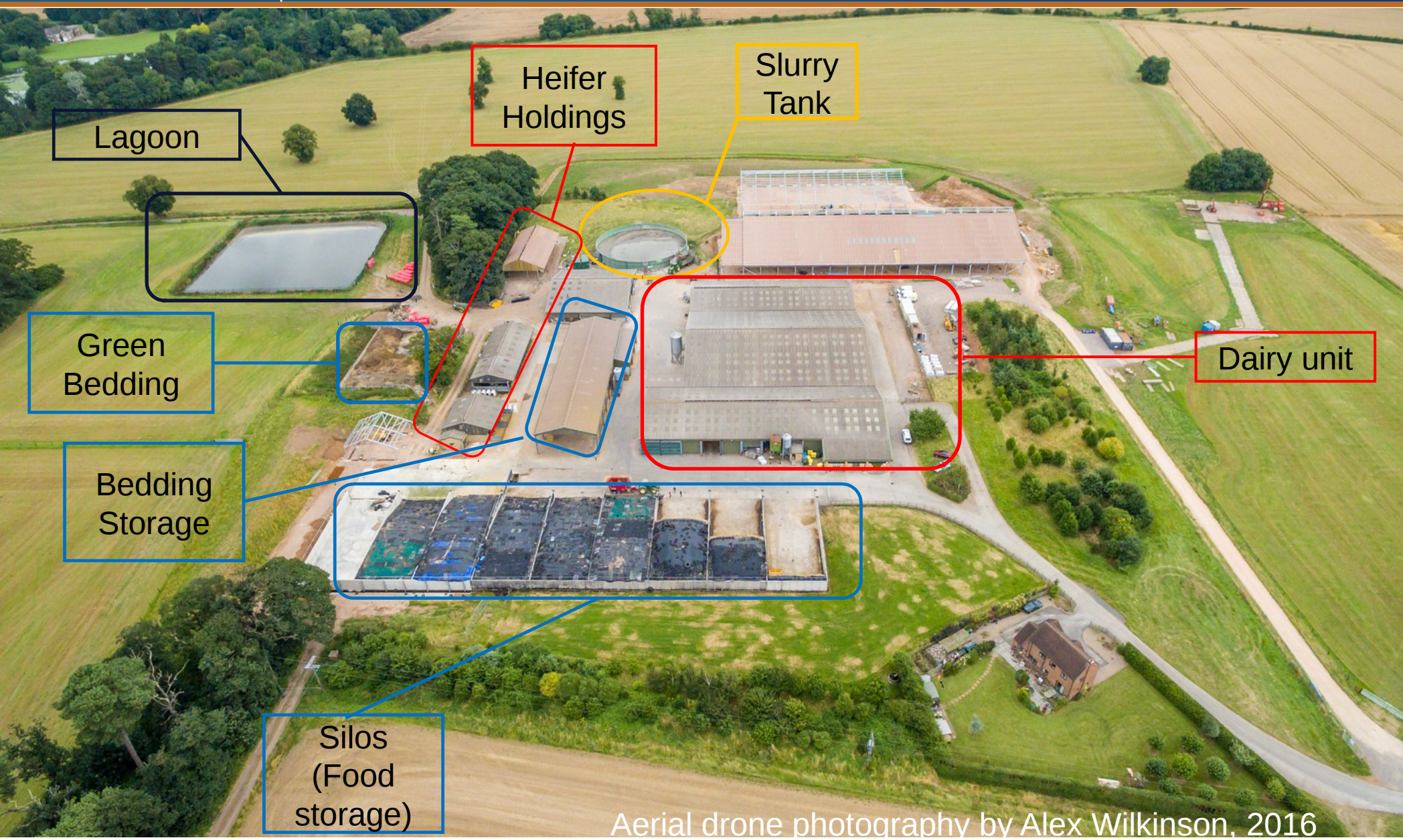
£6 million state-of-the-art dairy centre
240 to 360 high-yielding Holstein cows

3000 m³ slurry tank





Centre for Dairy Science Innovation, Sutton Bonington



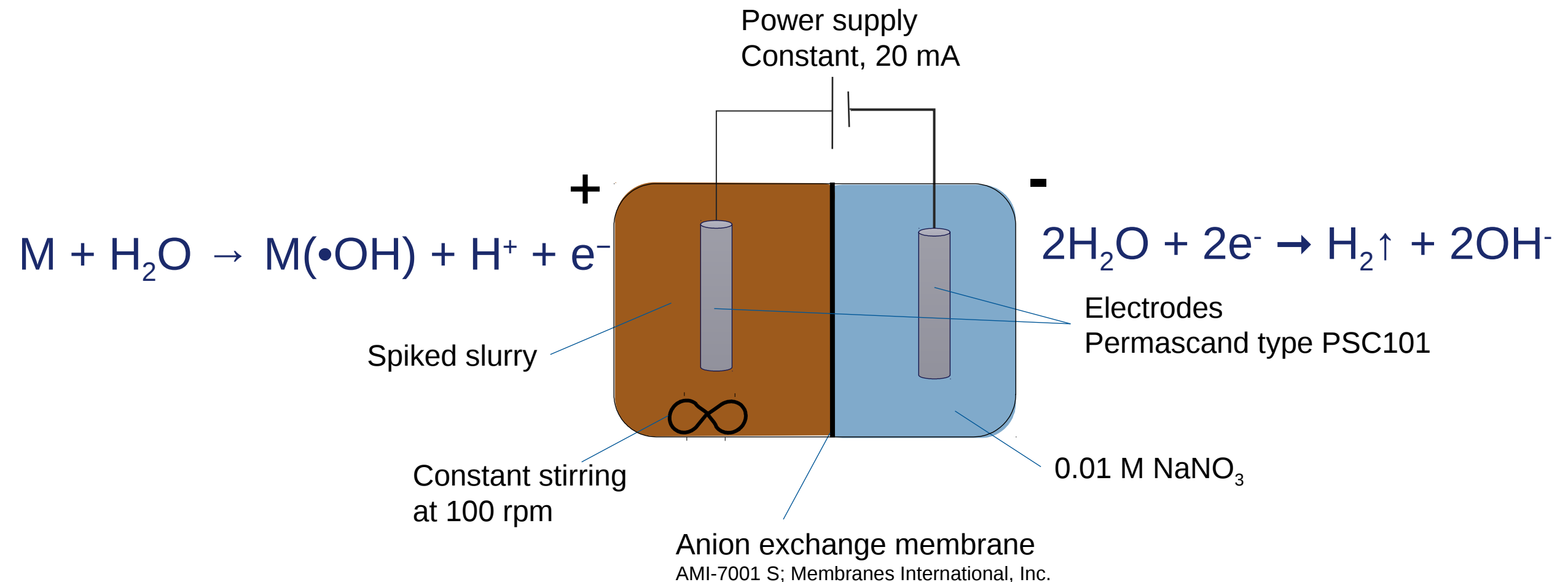
Antibiotics

Groups	Compounds	Abbreviation
Penicillins	Penicillin	PEN
	Amoxycillin	AMX
	Ampicillin	AMP
	Cloxacillin	CLOX
Cephalosporins	Cephalexin	CLX
	Cephoperazone	CPZ
	Cephquinome	CQM
	Cephthiofur	CFT
Lincosamides	Lincomycin	LCM
Aminocoumarins	Novobiocin	NOV
Tetracyclines	Oxytetracycline	OTC
Macrolides	Tylosin	TYL
Sulfonamides	Sulphadiazine	SDZ
	Trimethoprim	TMP

75 ng mL⁻¹



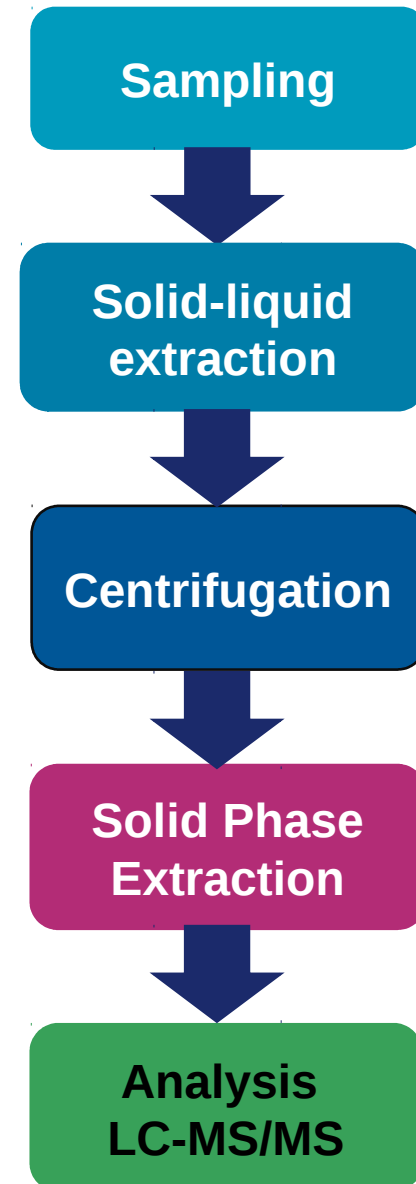
Advanced Electrochemical Oxidation





Experimental conditions

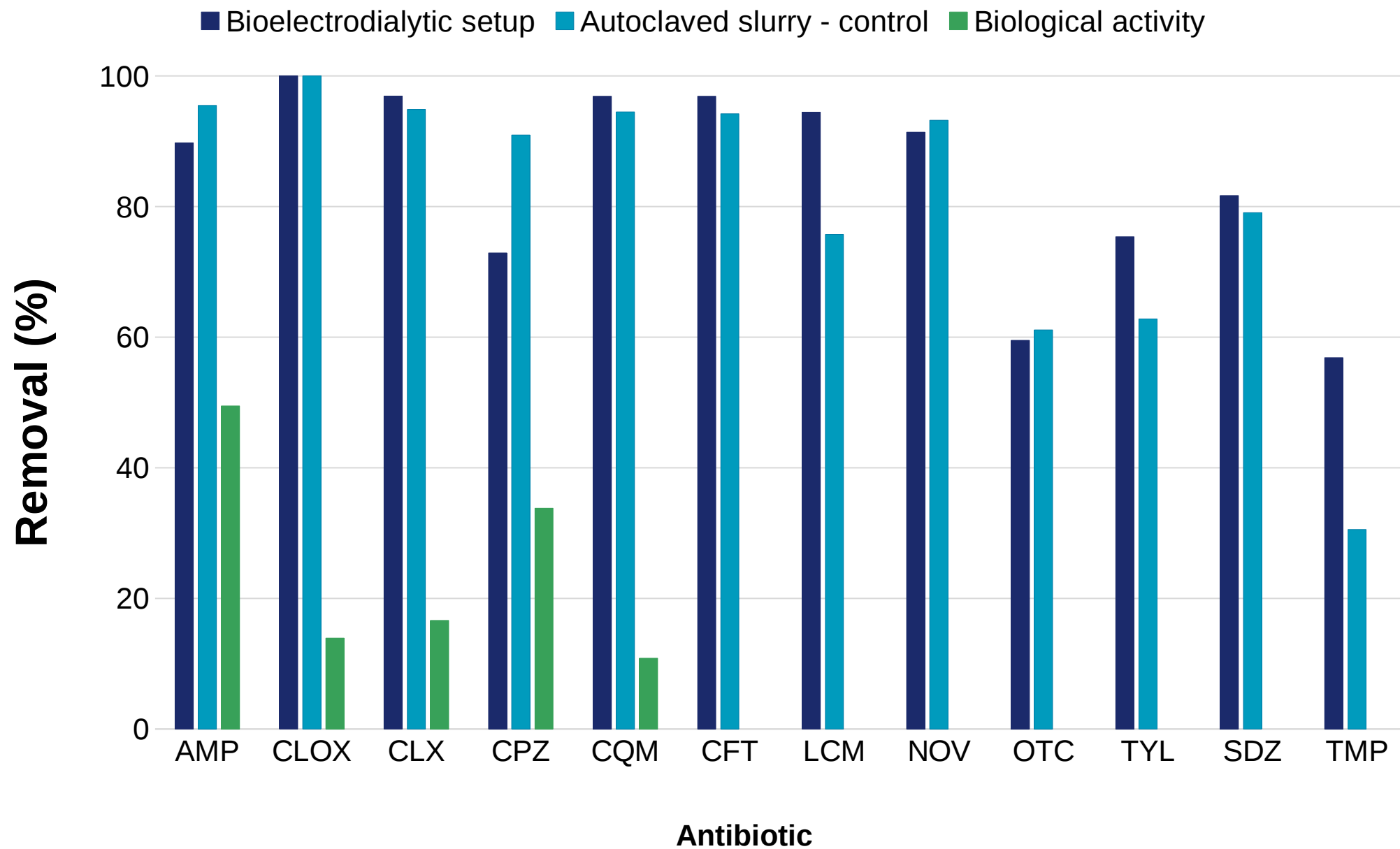
- Triplicate
- Dark conditions
- Controls: autoclaved slurry, no direct current
- 48 h duration
- Samples collected at 1, 2, 4.5, 8, 24, 30 and 48 h





- Recovery of antibiotics: 76-118%, except penicillins (10-20%)
- COD removal was 85% in the bioelectrodialytic setup, 66% in the control experiment with autoclaved slurry, and 15% in the control without electric current
- TSS removals were 48% in the bioelectrodialytic setup, 28% in the control experiment with autoclaved slurry, and 35% in the control without electric current

Results



Degradation processes were dominated by advanced oxidation, with the biological activity removing less than 50% of the initial concentration of the antibiotic

Feedstock shows high variability depending on the management practices and the climacteric conditions

Exciting area of research – further research on degradation products and pathways and antimicrobial resistance genes