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COMPREHENSIVE EVALUATION OF GRANULAR ACTIVATED CARBON FROM THE DEODORISATION SYSTEM OF A WWTP AND REGENERATION FOR SUBSEQUENT REUSE

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IWA the international water association

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Introduction

DEODORISATION BY GRANULAR ACTIVATED CARBON (GAC) IN WWTPS

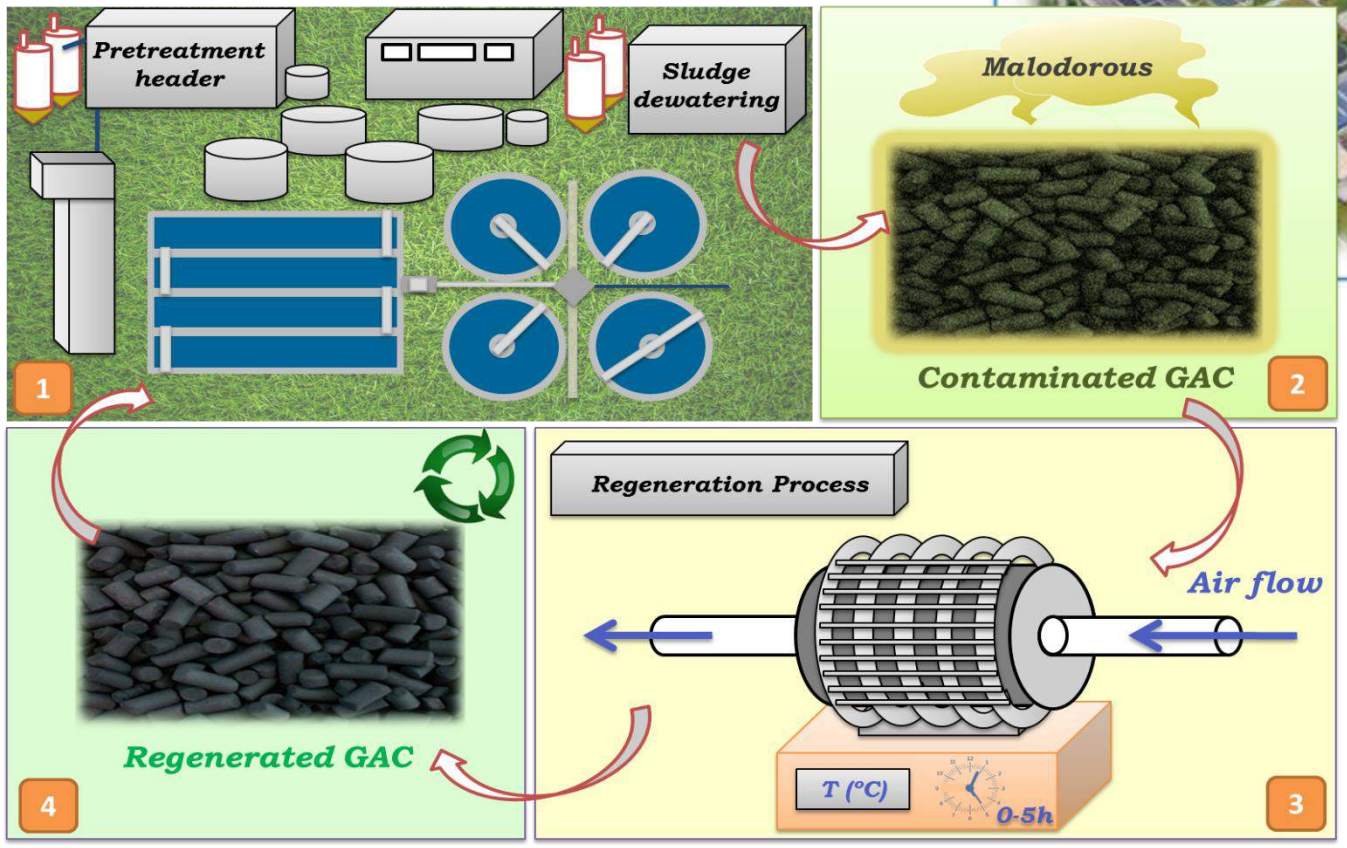
Landfill

VALORISATION

GAC regeneration

Objectives

1) Comprehensive evaluation of the used GAC by a multi-technical analysis

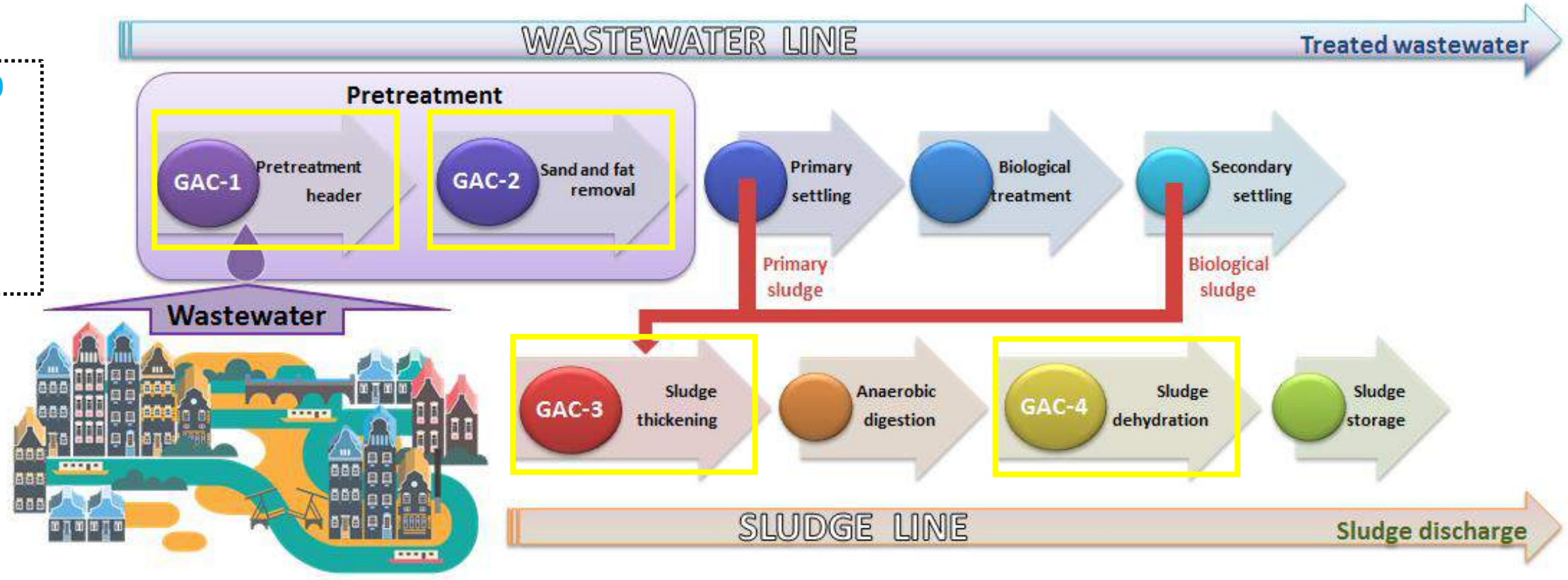


2) Study and optimization of the oxidative thermal regeneration of GAC

Methodology

Q = 255,000 m³/d

950,000 equivalent inhabitants



4 samples → GAC-1, GAC-2, GAC-3 and GAC-4

(operation time = 1 year)

Methodology

Physico-chemical characterisation

- TOC, TNs, pH and conductivity
- Elemental composition (S)
- Acidic and basic groups

Textural characterisation (B.E.T.)

S_{BET} / S_{micro} / V_{micro}

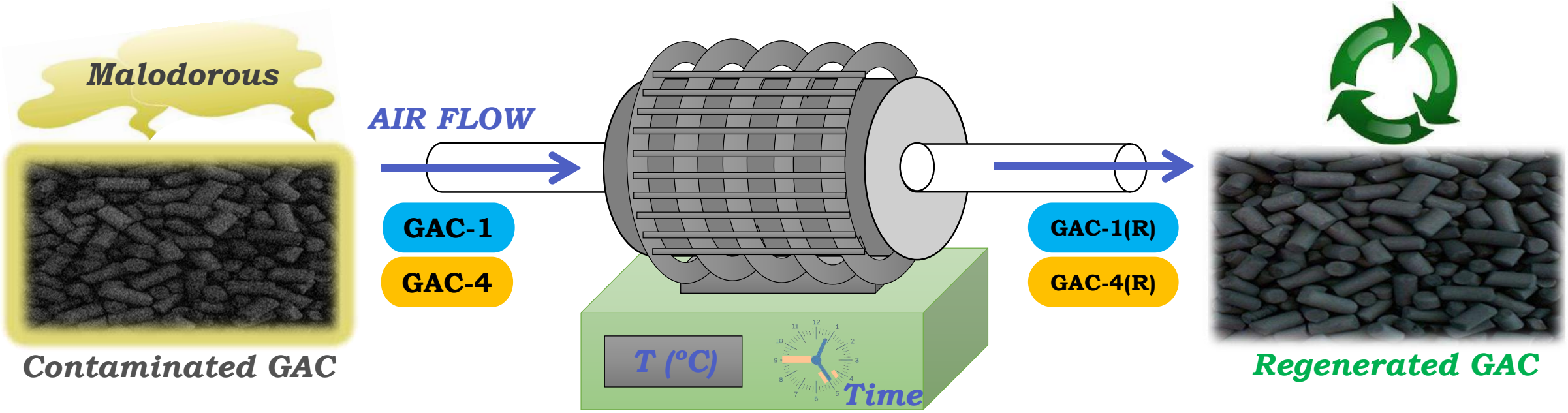
Olfactometric characterisation (EN 13725:2003)

Specific odour concentration ($ou_E/m^3 \cdot g$ GAC)

Chromatographic quantification (TD-GC-MS) & (GC-FPD)

Compound concentration (µg/g GAC)

Methodology



Characterisation

Physico-chemical

Textural

Olfactometric

Chromatographic

THERMAL REGENERATION

Limit regeneration temperature

Characterisation

Physico-chemical

Textural (B.E.T.)

Structural (XRD)

Results & Discussion

CHARACTERISATION OF THE USED GAC

GAC samples	Boehm method		X-ray fluorescense
	Basic groups [OH^-] (mmol/g GAC)	**Acidic groups** [H^+] (mmol/g GAC)	**S** (% by weight)
GAC-1	-	2.73 ± 0.38	15.25 ± 1.02
GAC-2	-	1.89 ± 0.28	5.09 ± 0.14
GAC-3	2.31 ± 0.06	-	0.50 ± 0.02
GAC-4	1.88 ± 0.25	-	0.57 ± 0.02

WASTEWATER LINE

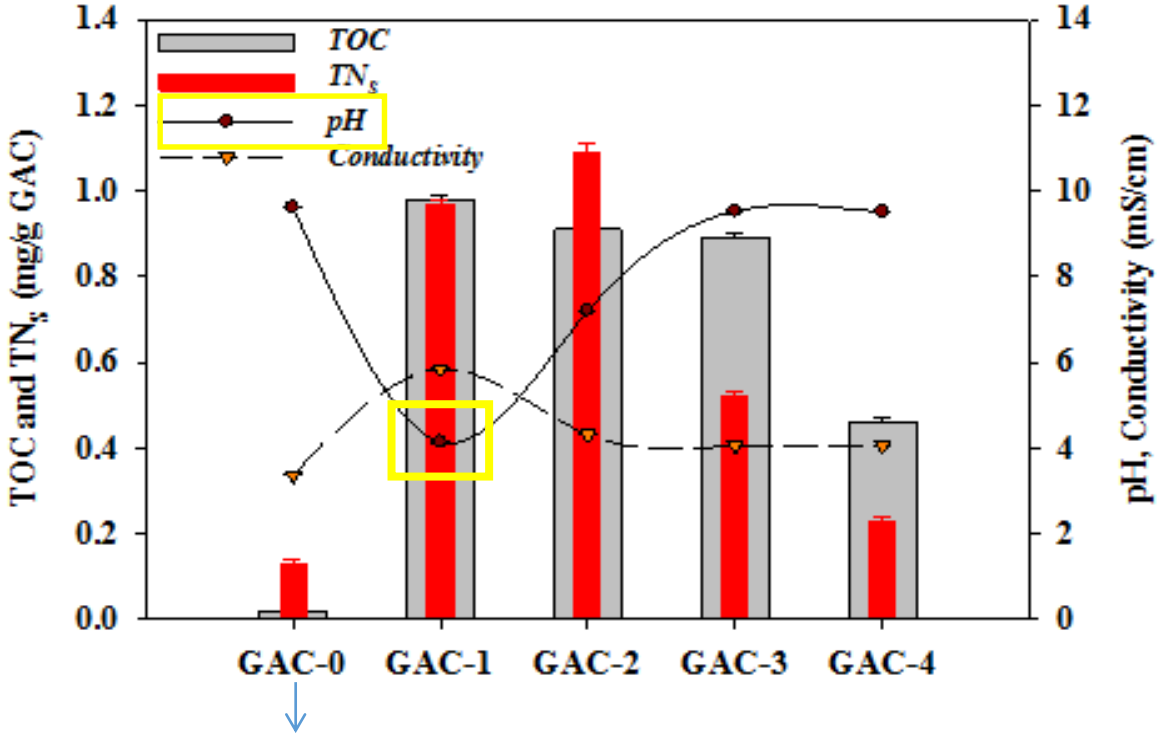
GAC-1: Pretreatment header

GAC-2: Sand and fat removal

SLUDGE LINE

GAC-3: Sludge thickening

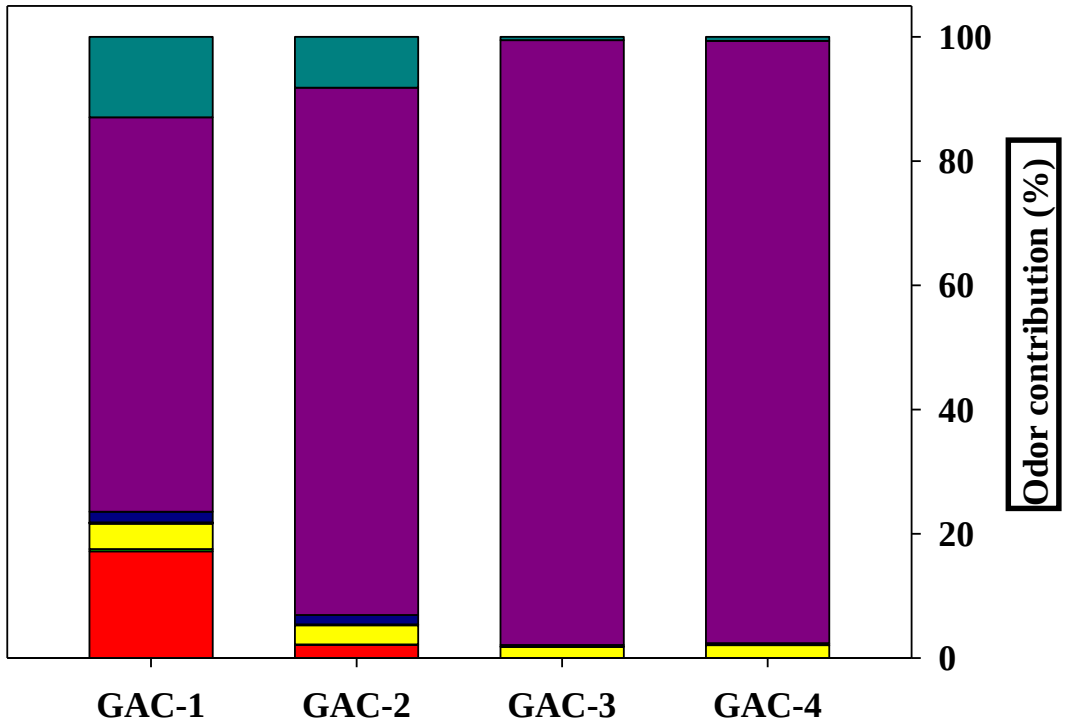
GAC-4: Sludge dewatering

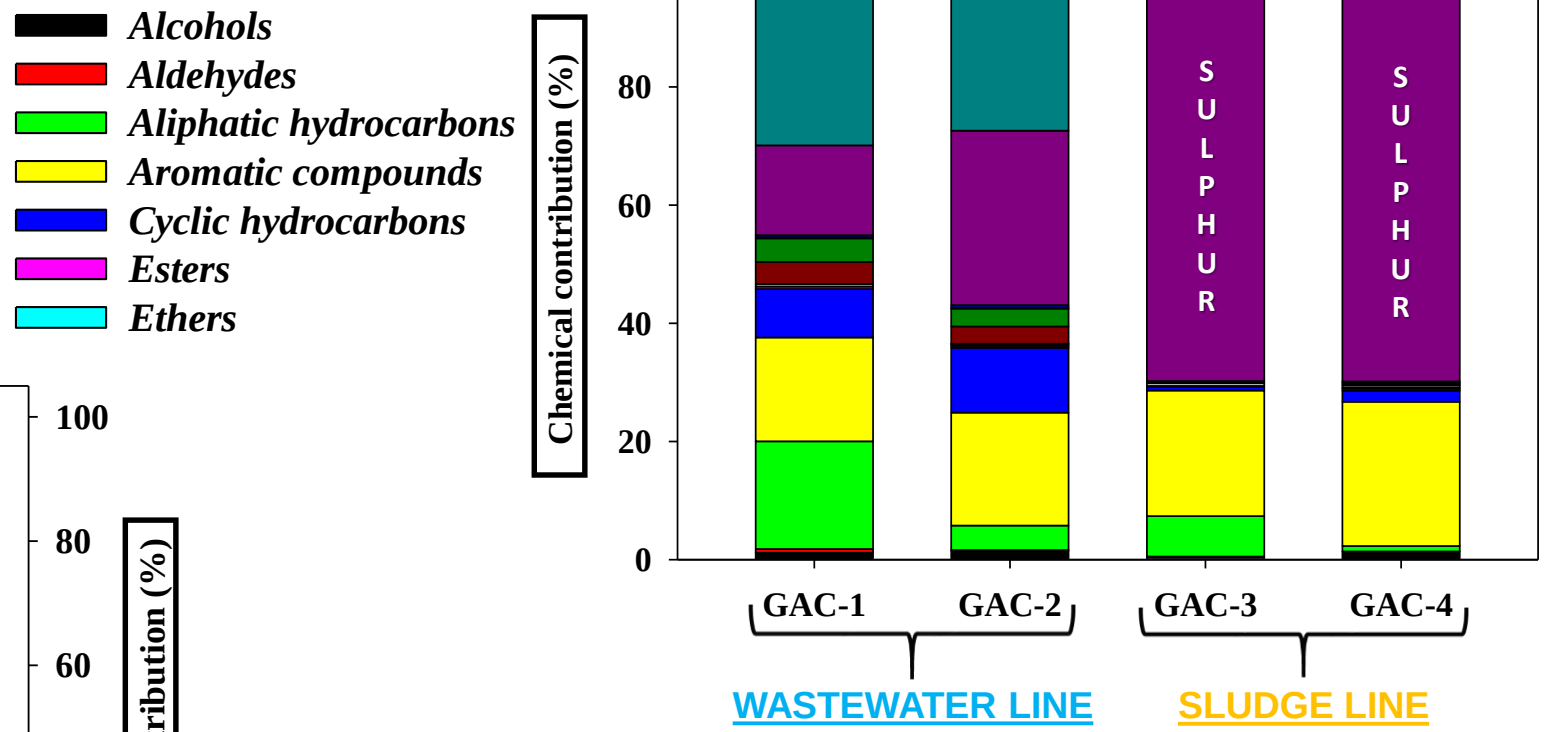


Pristine GAC sample

Results & Discussion

GAC-1: Pretreatment header
GAC-2: Sand and fat removal
GAC-3: Sludge thickening
GAC-4: Sludge dewatering





Furans
Halogen-containing compounds
Ketones
Nitrogen-containing compounds
Organic acids
Sulfur-containing compounds !!
Terpenes

Results & Discussion

GAC samples	S_{BET} (m^2/g)	S_{micro} (m^2/g)	V_{micro} (cm^3/g)
GAC-0	406	236	0.180
GAC-1	**36**	**-**	**0.012**
GAC-2	156	63	0.049
GAC-3	336	229	0.170
GAC-4	328	169	0.145

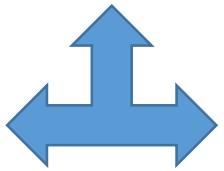
GAC-0: Pristine GAC sample

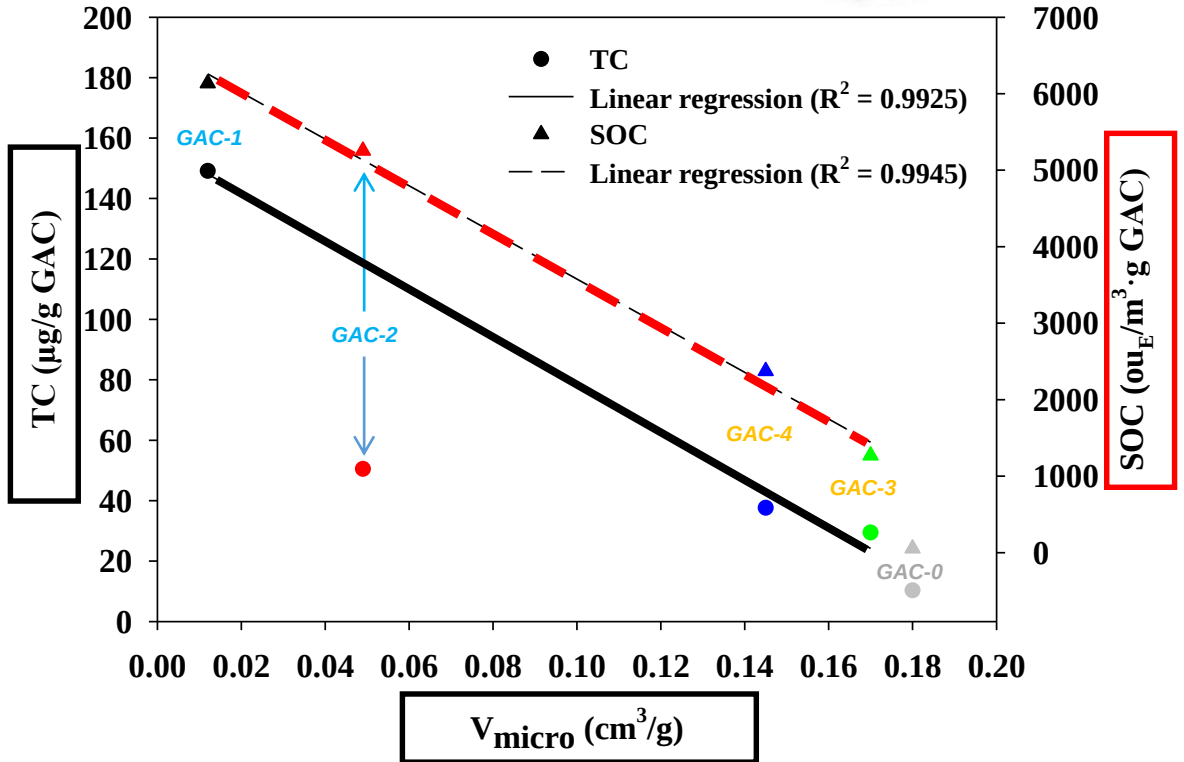
GAC-1: Pretretment header
GAC-2: Sand and fat removal

GAC-3: Sludge thickening
GAC-4: Sludge dewatering

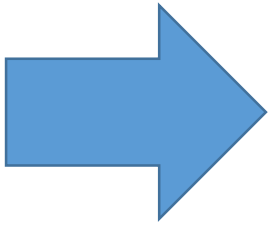
TC: Total concentration of desorbed gaseous compounds at 40ºC

SOC: Specific odour concentration at 40ºC





Results & Discussion



Comprehensive evaluation of the used GAC

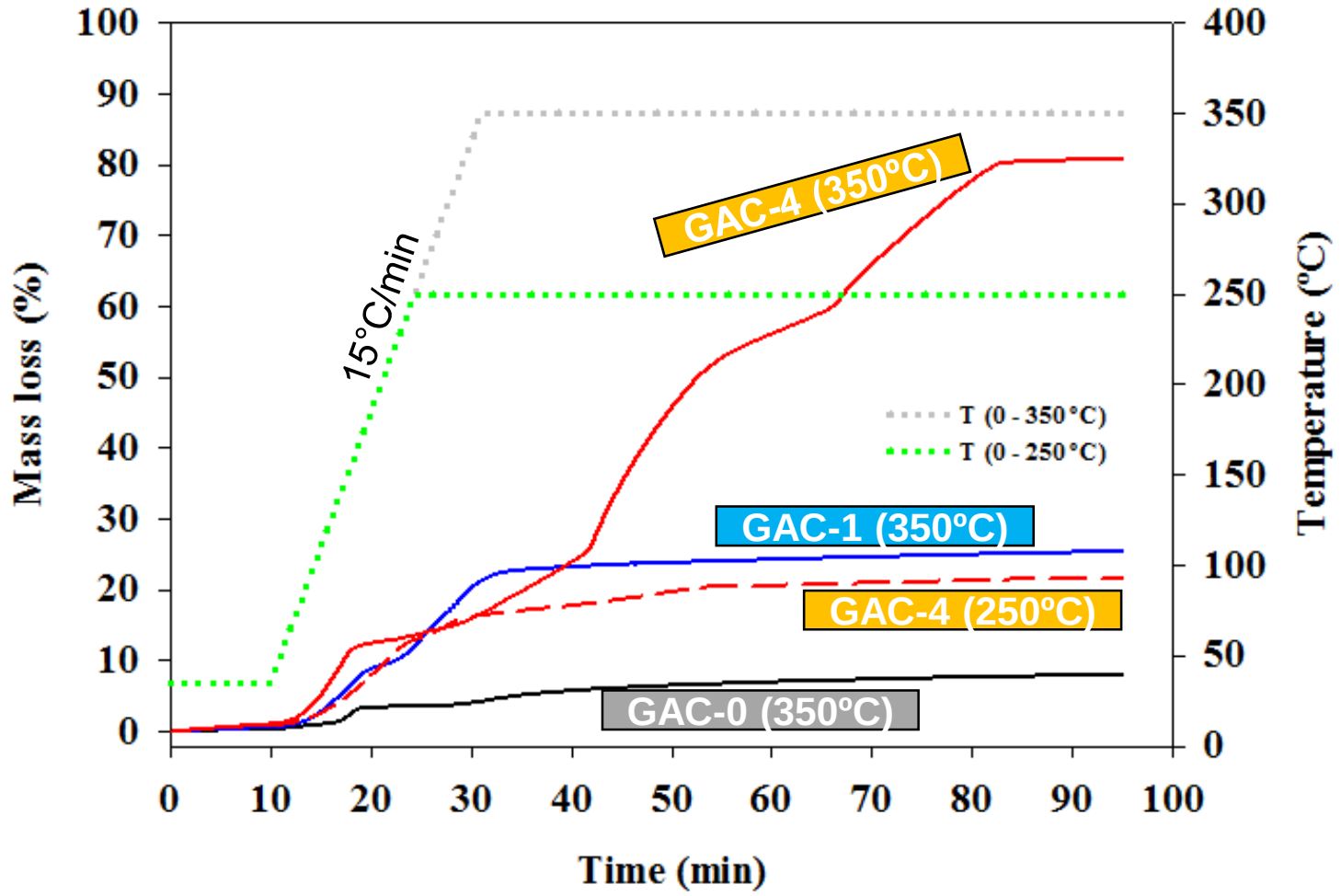
Regeneration of the GAC

Results & Discussion

Assessment of the LIMIT REGENERATION TEMPERATURE

GAC-1 (wastewater line)
350°C

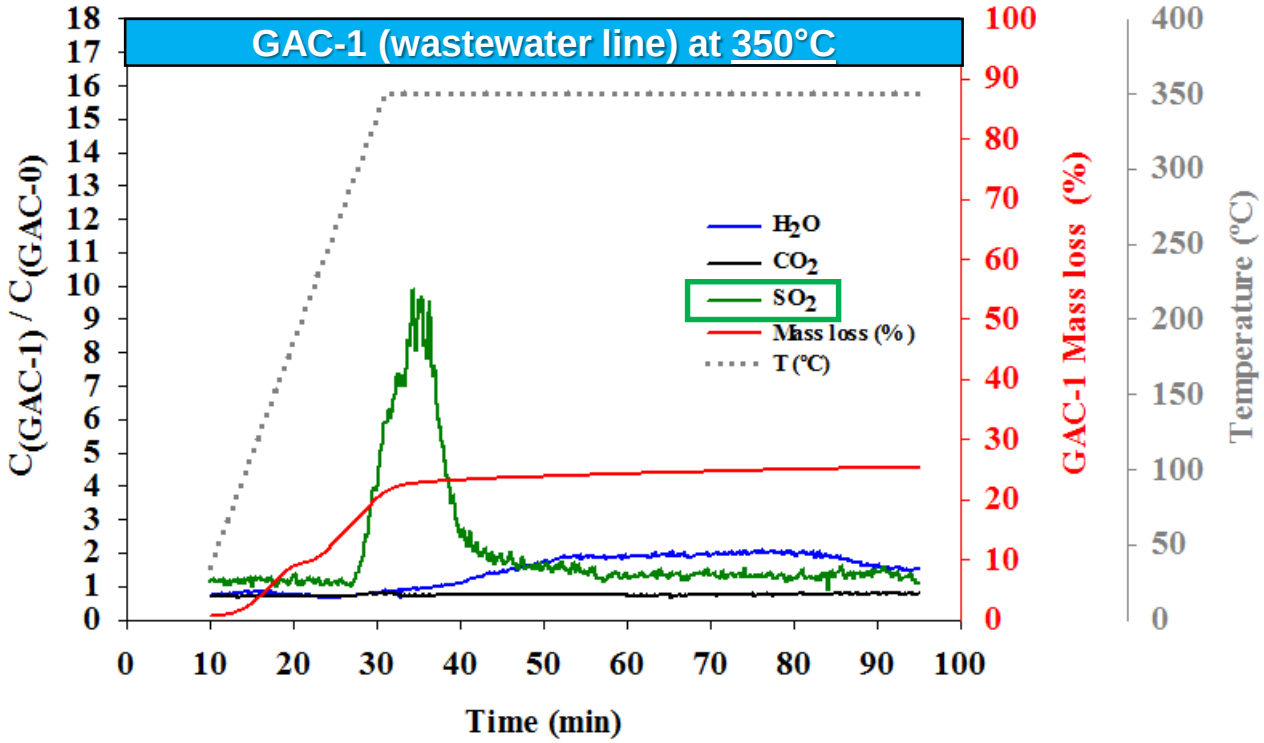
GAC-4 (sludge line)
250°C

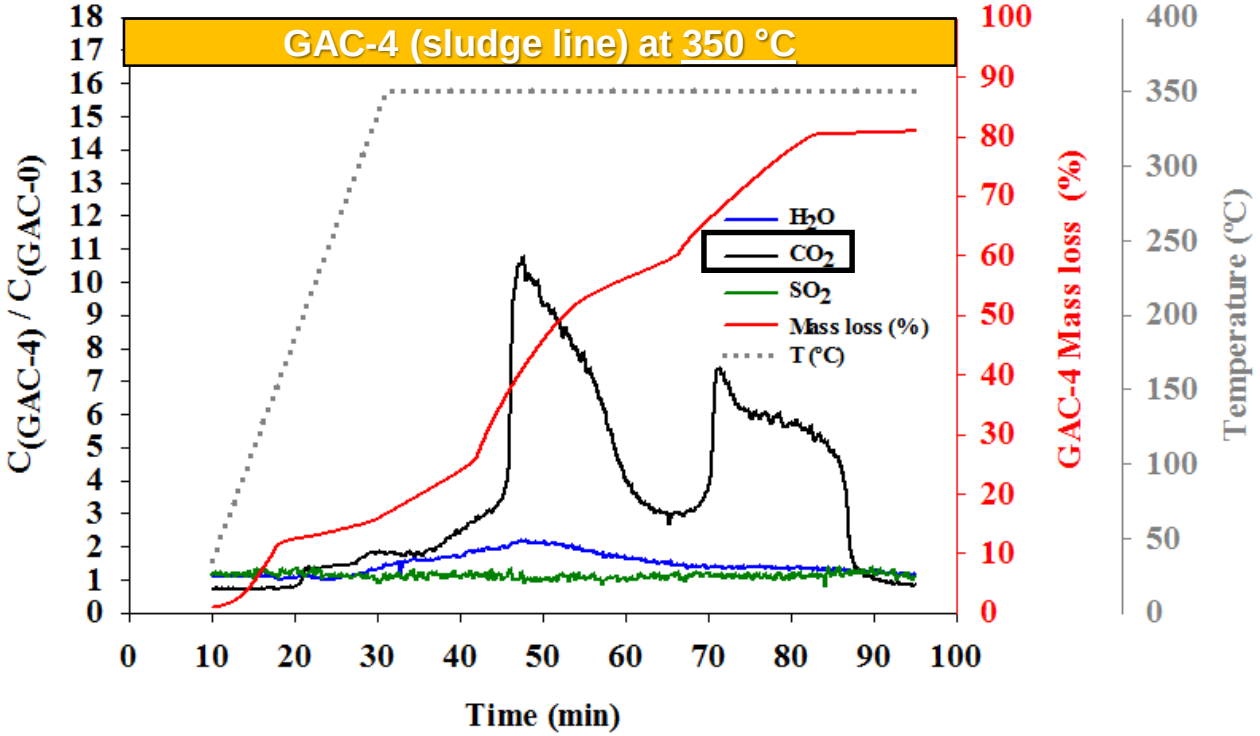


Results & Discussion

Analysis of H_2O, CO_2 and SO_2 emitted during the thermogravimetric analysis (TGA)

TGA-MS coupling





T = 350°C

GAC-1

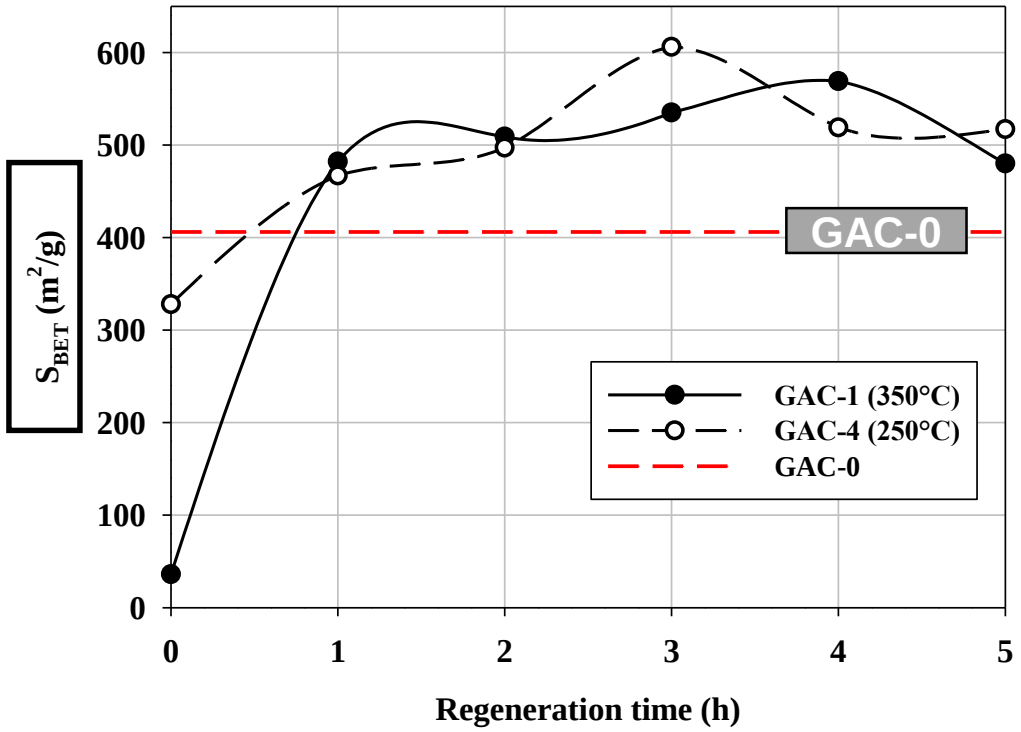
$2H_2S+3O_2 \rightarrow 2\underline{SO_2}+2H_2O$

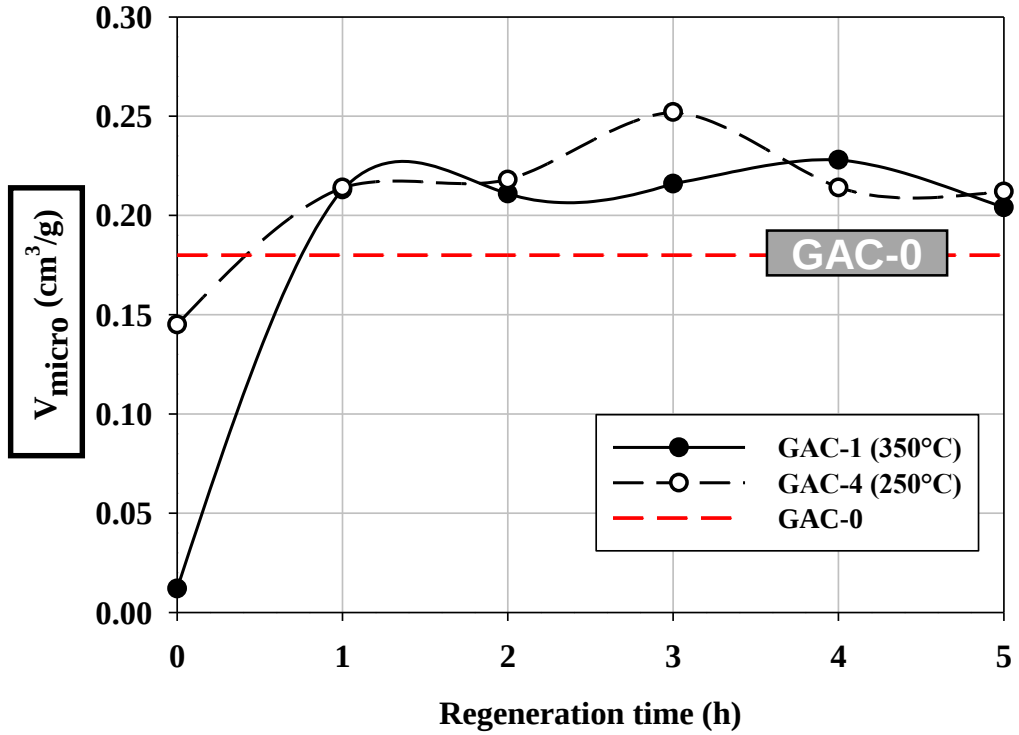
GAC-4

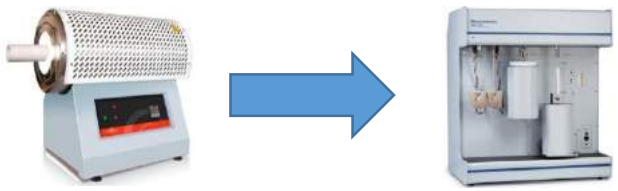
$C+O_2 \rightarrow \underline{CO_2}$

Results & Discussion

Assessment of the REGENERATION TIME



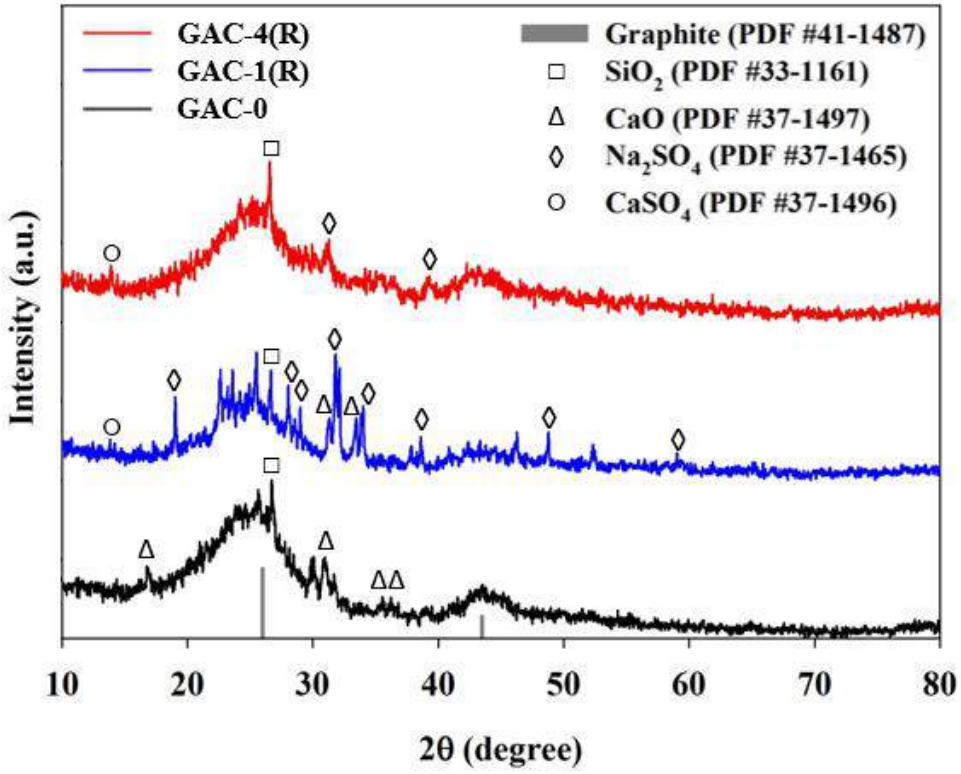




GAC samples	Regeneration time (h)	Regeneration efficiency (%)
GAC-1(R)	1	81 ± 1
GAC-4(R)	1	98 ± 1

Results & Discussion

Post-regeneration characterisation



The regenerated GAC maintains a practically unchanged crystalline structure

	GAC-0	GAC-1	GAC-1(R)	GAC-4	GAC-4(R)
Acidic groups [H^+] (mmol/g GAC)	-	2.73 ± 0.38	1.05 ± 0.14	-	-
Basic groups [OH^-] (mmol/g GAC)	2.11 ± 0.21	-	-	1.88 ± 0.25	1.20 ± 0.25

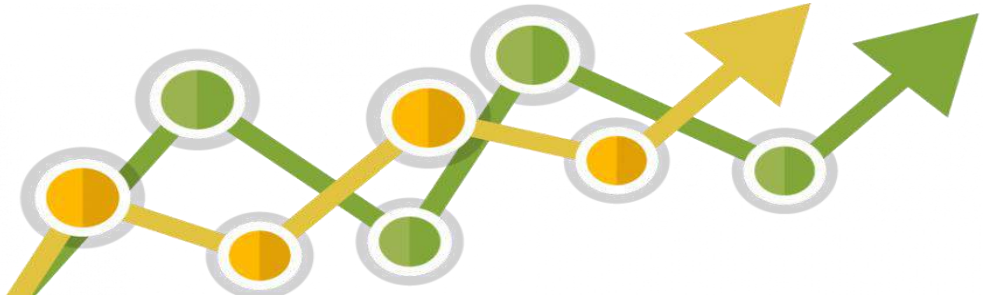
Conclusions

Better evidence of the saturation level of GAC beds

Multi-technical analysis

Optimization of the GAC use

Air quality improvement



Conclusions

Oxidative thermal regeneration

GAC reuse

- **Costs**
- **Waste accumulation**
- **Raw materials**

Acknowledgements

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