In-situ Regeneration of Activated Carbon for Water Treatment: Chemical Regeneration

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Stream

The Industrial Doctorate Centre for the Water Sector

Chemical Regeneration

Overview:

The most common carbon regeneration technique practiced is thermal regeneration, which must be done off-site.

The presence of some pesticides can cause early GAC bed exhaustion, requiring more frequent regeneration and increased additional costs.

An in-place partial or a complete GAC regeneration, using **chemical regeneration techniques**, is being investigated.

- **The main principle:** The exhausted carbon is contacted with regeneration solutions which have the ability to desorb contaminants.
- **The main challenge:** Selecting the appropriate chemicals for the tests, since the effectiveness of chemical regeneration is dependent on the regenerant solutions and the contaminants[1].

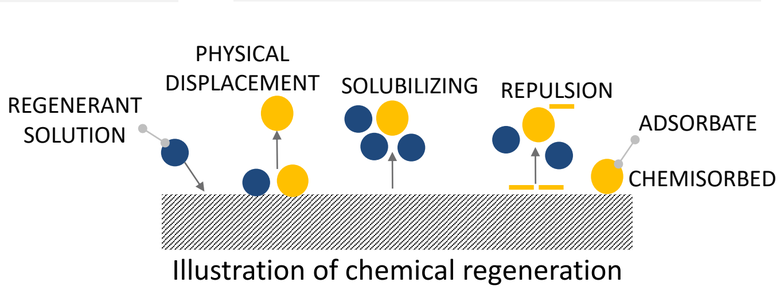


Illustration of chemical regeneration

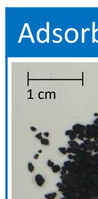
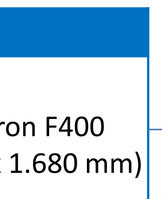
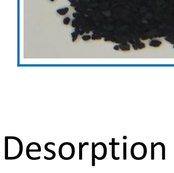
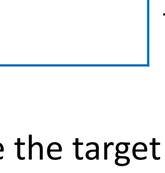
Aims:

To investigate feasible, yet practical, regenerant solutions that are:

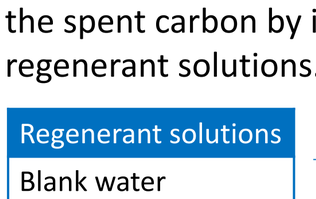
- Able to regenerate efficiently spent carbon exhausted by current and future pollutants.
- Safe for infrastructure.
- Cause no harm to operators and consumers.

Method: Batch Tests

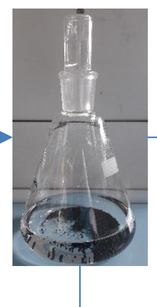
1. Adsorption test to load target contaminants onto the carbon prior to desorption/regeneration.

Target contaminants	
 Phenol Log k_{ow} = 1.46	 Isoproturon Log k_{ow} = 2.5
 Nitrobenzene Log k_{ow} = 1.85	 Clopyralid Log k_{ow} = 1.06

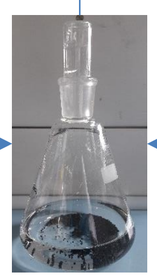
Adsorbent



Chemviron F400 (0.420 x 1.680 mm)



The flasks were agitated using a platform shaker



2. Desorption test to remove the target contaminants from the spent carbon by impregnating the carbon in regenerant solutions.

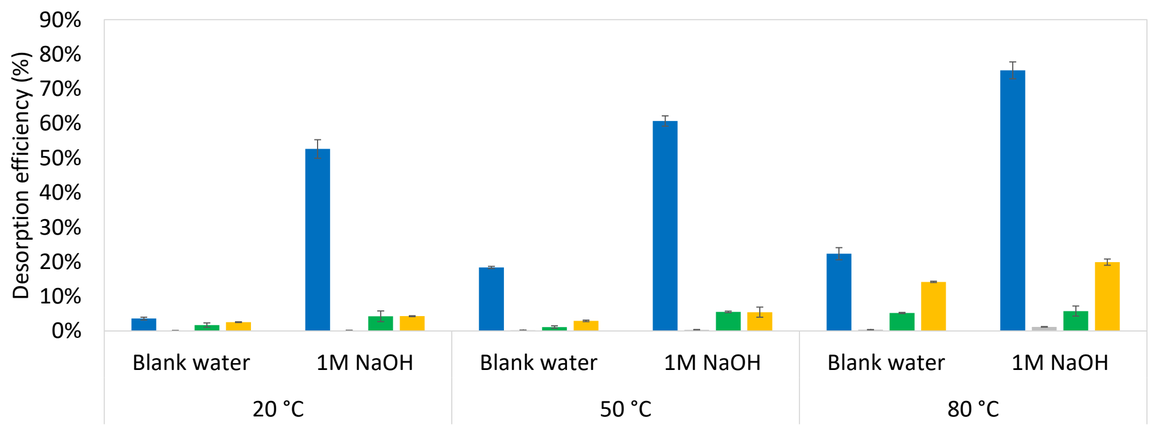
Regenerant solutions
Blank water
Sodium hydroxide
Acetic acid

at 20, 50 and 80 °C

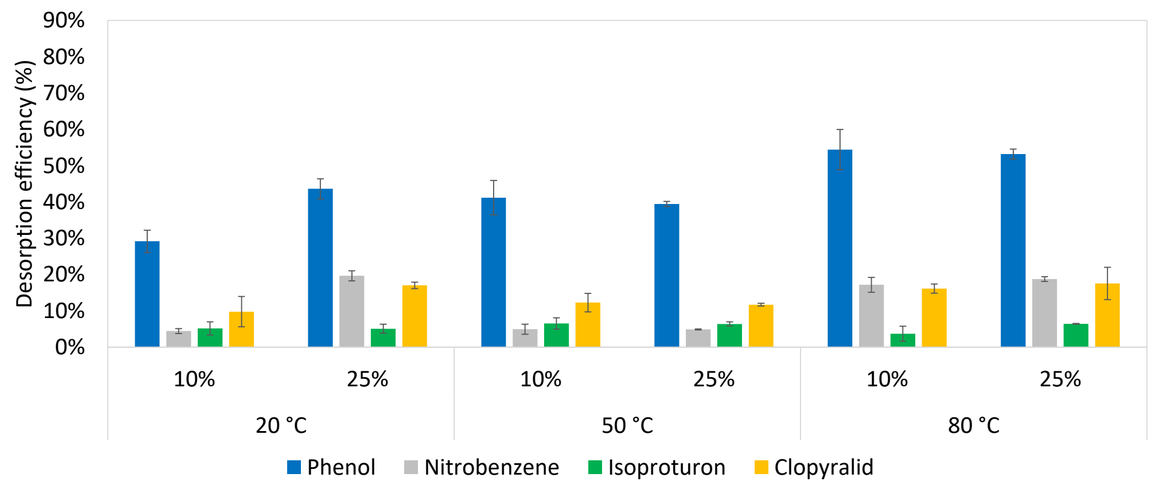
3. The target contaminants concentration were analysed using a UV-visible spectrometer.

Results and Discussion

Sodium hydroxide



Acetic acid



1. The phenolic contaminants (representatives of organic contaminants in water) were easily desorbed using alkaline solution, i.e. sodium hydroxide via transformation[2].
2. The aromatic contaminants with electron withdrawing functional groups, such as nitrobenzene and clopyralid, were able to be removed using acetic acid at moderate concentrations.
3. The contaminant with a high hydrophobicity characteristic, isoproturon, is strongly bonded to the carbon and was difficult to desorb via the chemical regeneration techniques considered so far.

Conclusions

1. Contaminants that are highly hydrophobic are difficult to desorb via the chemical regeneration techniques considered so far.
2. Contaminants that are relative hydrophilic can be removed from the exhausted carbon by increasing the temperature of the regenerant solution.
3. The findings so far suggest that it would be worthwhile to consider the use of more than one type of chemical for the regeneration to remove a wide range of contaminants.

Acknowledgement

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References

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[2]Martin, R. J., & Ng, W. J. (1984). Chemical Regeneration of Exhausted Activated Carbon - I. *Water Research*, *18*(l), 59–73.

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