TIGG LLC
Carbon Adsorber Systems
• TIGG has designed and built systems to purify vapors and liquids for over 40 years

• Headquarters in Oakdale, PA with manufacturing in Heber Springs, AR

• Product mix includes systems for use in the municipal and industrial markets

• Ability to incorporate various types of media into our systems

• Available systems sizes from 55 gallon drums to 14 foot diameter vessels

• Provide solutions with system sales or lease options

• Larger systems are certified by NSF to NSF 61 Requirements
Coal Based

Aliphatic dislocation (imperfection) of plate

Graphite Plate

Interbonding of plates
Coconut Shell Based
What is Adsorption?

• Physical process in which molecules of one substance are attracted onto the surface structure of another.

• Molecules which are being removed from gaseous or liquid streams via activated carbon are called adsorbates.
How does an adsorption system work?

• First step is to properly deaerate the carbon bed. Air in the pores means it is not available for adsorption.

• Water travels down flow in a plug type fashion and the contaminants are adsorbed.

• The zone where adsorption takes place is called the Mass Transfer Zone (MTZ).

• As the carbon reaches its capacity the MTZ moves down through the bed.

• Collectors on the bottom of the bed filter the clean water while holding back the granular carbon.
(MTZ) Mass Transfer Zone Movement Over Time

A

B

C
At what level do you exchange?

1st Detection

75% spent

50% spent

25% spent

Sample Ports

Influent

Effluent
ADSORPTION PROCESS

• Once the water has passed through the carbon bed, it is collected at the bottom of the vessel with an underdrain system.

• The filtration system can be sized to operate in a series (LEAD/LAG) or parallel mode. The series mode is very common and the most efficient use of the carbon bed.
INTERNALS

• Underdrain Collection System
  – Header/Lateral system
  – Stainless Steel

• Inlet Water Distributor
  – Stainless Steel
Stainless Steel Internals
Typical System / Modular Configuration
Operational Considerations

• Concentration of adsorbate
  • Higher concentrations result in higher loading capacities on carbon.

• Flow rate and contact time
  • Sets size constraints for equipment size

• Length of the mass transfer zone
  • Determines operational configuration of the equipment

• Adsorption system start up and future replacement
System Sizing Standards
Per vessel

• Flow – No more than 9 GPM / SQ FT of cross sectional area and no less than 1 GPM / SQ FT

• Contact Time – 10 to 15 Minutes

• Backwash – 12 to 14 GPM / SQ FT

• A pilot study or quick column test will assist in determination performance and the proper sizing
(RSSCT) Rapid Small Scale Column Test

- Compare the performance of several medias for particular contaminants
- Predict the bed-life of a media in the full-scale facility
- Months of full scale data in days with very low water requirements
- Media selection based on cost per unit of contaminant removed, not the cost per unit weight.
- Normal measurement in bed volumes
Rapid Small Scale Column Test

**Series Flow**

- X Contact Time
- X Sample Port
- 2X Contact Time
- 2X Sample Port

**Single or Parallel**

- Multiple Media Samples Can Be Tested Simultaneously Using A Manifold

Purifying Air & Water
Backwash of GAC Bed

- Initial Backwash to stratify bed and remove fines
- 12-14 GPM / square foot of cross sectional area. Approximately 900 gpm for 30 minutes or 27,000 gallons of water to waste.
- Backwash during life of GAC is nominal and dependent upon water quality.
GAC Filling & Replacement

Slurry In / Out

Dry Fill / Slurry Out
VALVE / PIPE RACK

- Modular Design With Logical Layout
- Manual or automated valve package
- Local control panel available
- Ability to configure for various flows:
  A. Lead – Lag and reversal to Lag - Lead
  B. Isolation of either vessel
  C. Parallel
  D. Backwash
Modular 12 Valve Pipe Rack
Modular Valve / Pipe Rack Installation
Standard 10’ 12’ and 14’ Vessel Design Specifications
Standard 10’ 12’ and 14’ Vessel Design Specifications
Typical Construction Process

1. Offload and set two vessels and pipe rack
2. Attach interconnecting pipes from pipe rack to vessels
3. Connect yard piping to pipe rack
4. Disinfect system and piping
5. Load GAC into vessels
6. De aerate GAC
7. Initial backwash of GAC beds
8. Start system
Pitfalls to Avoid

• Determine what is in the water

• Other constituents will compete for space

• Solids (turbidity) will cause channeling
TIGG Underdrain Benefits

- Lower overall height
- Pinhole free liner
- Durable
- Efficient carbon removal
- Less manways
- Ease of service / inspection
- Flow characteristics
Lateral Underdrain Lower Overall Height

- The underdrain sits deep into the bottom head.
- Lateral underdrain vessels are more than 3’ shorter than typical false-bottom vessels.
Durable Underdrain Internals

- Stainless steel construction of header, wedge wire laterals, clips and supports
Efficient Carbon Removal

• Two step process
  1. Slurry out spent carbon
  2. Short rinse to remove any remaining media

It is not necessary to open the vessel except for inspection. Sight glass in slurry line indicates when carbon has been removed.
Less Manways

There is no need to access from the bottom head since all activities can be performed from a manway on the lower straight side and/or top head.
Ease Of Service / Inspection

- Access through a lower straight side manway allows service personnel a safe entry and exit with firm footing between the laterals.

- Wedge wire laterals can be individually removed by one person IF there were ever a need to do so.
Other Considerations

NSF

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The Public Health and Safety Organization

**NSF Product and Service Listings**

These NSF Official Listings are current as of Wednesday, September 26, 2018 at 12:15 a.m. Eastern Time. Please contact NSF International to confirm the status of any Listing, report errors, or make suggestions.

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**NSF/ANSI 61**

**Drinking Water System Components - Health Effects**

NOTE: Unless otherwise indicated for Materials, Certification is only for the Water Contact Material shown in the Listing. Click here for a list of Abbreviations used in these Listings. Click here for the definitions of Water Contact Temperatures denoted in these Listings.

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800-925-0011
723-370-3920

Visit this company's website (http://www.tigg.com)

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Facility: Heber Springs, AR

### Mechanical Devices

<table>
<thead>
<tr>
<th>Trade Designation</th>
<th>Size</th>
<th>Water Contact Temp</th>
<th>Water Contact Material</th>
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<tbody>
<tr>
<td>CP20K-8[1]</td>
<td>8&quot;</td>
<td>CLD 23</td>
<td>MLTPL</td>
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<td>CP20K-10[2]</td>
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<td>CP20K-12[3]</td>
<td>12&quot;</td>
<td>CLD 23</td>
<td>MLTPL</td>
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Carbon Interferences or Concerns

• Other organic compounds present will load onto carbon to reduce media bed life
• Suspended solids will foul bed but carbon maybe backwashed from clean water source
Carbon Advantages

• Removes TOC in addition to PFAS
• Can be backwashed
• No interference from high TDS
• No interference from inorganic contaminants such as sulfate, nitrate, or ammonia
• Carbon can be reactivated
Issaquah, WA 10’ diameter Skid Mounted System
## Issaquah, WA

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<th>Sample Port</th>
<th>Contaminant</th>
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<td>Treated ug/l</td>
<td>Raw ug/l</td>
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### Summary of Results from Issaquah, WA

<table>
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<tr>
<th></th>
<th>Coconut Carbon in Lead</th>
<th>Coal Carbon in Lead</th>
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<tbody>
<tr>
<td><strong>Time of Service</strong></td>
<td>11 months</td>
<td>21 months</td>
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<tr>
<td><strong>Water Processed</strong></td>
<td>102 million gallons</td>
<td>200 million</td>
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<td><strong>PFCs Removed</strong></td>
<td>0.529 pounds</td>
<td>0.76 pounds</td>
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<tr>
<td><strong>Bed Volumes w/o Breakthrough</strong></td>
<td>19,092</td>
<td>37,005</td>
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<tr>
<td><strong>Backwash cycles during period</strong></td>
<td>4+6**</td>
<td>22</td>
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</tbody>
</table>

**During the first months of operation,**

Pressure swings caused rupture disc failures resulted in 6 unintended and uncontrolled backwash incidents.
Conclusions:

• The remediation and removal of PFAS is still in its infancy

• The PFAS issue is serious and global

• GAC is used in the majority of applications and IX selective resins are seeing site specific applications

• New technologies for the removal process are still in the research mode and may be years before they can be scaled up to Municipal applications

• Use NSF 61 Certified products
Questions?

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