

Picking the Right Carbon for Your 3D Printer

Choosing the optimal activated carbon for a specific task requires careful consideration of several key factors, including surface area, CTC/benzene efficiency, porosity, and pH. These properties play a crucial role in determining the effectiveness and efficiency of the activated carbon in adsorbing target contaminants!

Surface area is perhaps the most critical factor, as it directly influences the adsorption capacity of the activated carbon. A higher surface area allows for more adsorption sites, enabling the activated carbon to capture and retain a greater amount of contaminants. Activated carbons typically range from 500 to 1250 m²/g, and a carbon of 1200 m²/g would have twice the capture capacity compared to a 600 m²/g carbon. A good carbon usually has at least 1000 m²/g.

Be sure you're not getting scammed by buying 25% cheaper carbon that lasts half as long!

CTC (Carbon Tetrachloride) efficiency - or even better for 3D printing applications, aromatic hydrocarbon efficiency - is another important consideration, as it measures the activated carbon's ability to adsorb volatile organic compounds created from 3D printing. A higher CTC efficiency indicates a greater proportion of micro-pores, which are essential for capturing - and holding on to - small contaminants like airstream VOCs. Choosing an activated carbon with a CTC efficiency that matches the size of the target contaminants ensures optimal adsorption performance. A good carbon usually has at least 60% CTC.

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Porosity, which refers to the distribution of pore sizes within the activated carbon, also plays a significant role. Activated carbons, depending on quality and carbon source, will have different ratios of micro-pores (<2 nm), meso-pores (2-50 nm), and macro-pores (>50 nm). For general use, an even mix might be preferred, as they can effectively capture a broad spectrum of contaminants while allowing for efficient mass transfer and regeneration. However, for 3D printing use, a high micro- and mesoporosity is ideal to both capture VOCs (<2 nm) and VOC-agglomerates (ultra-fine particles, <50 nm), whereas macropores will struggle to hold on to VOCs in a hot application like a 3D printer's heated chamber. Good carbon types for our application are usually sourced from coconut or anthracite, as they are highly microporous, whereas other common carbons, such as bamboo or bituminous, usually have a larger percentage of macropores.

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The pH of your activated carbon should be considered, especially when dealing with pH-sensitive applications or contaminants. Activated carbons with a neutral or

slightly alkaline pH are suitable for most applications, while acidic or basic activated carbons may be required for specific tasks. In order to capture any VOC type generated from any filament, a neutral carbon (capable of binding to both neutral, acidic, and alkaline VOCs) is preferred. Some users have also experienced severe printer corrosion from using acid-contaminated/treated carbon that, for some reason, got released with the heating cycles.

Be sure to buy a 3D printer-safe carbon that is steam-activated and not acid-treated/coated!

Compare carbons in a jiffy

As a general comparison number for neutral carbons, try multiplying surface area and CTC efficiency (available space * capturing efficiency):

Carbon A: $1250 \text{ m}^2/\text{g} * 80\% \text{ CTC}$ would be $1250 * 0.8 = 1000$ (*yes, this is Nevermore specs*)

Carbon B: $1000 \text{ m}^2/\text{g} * 50\% \text{ CTC}$ would be $1000 * 0.5 = 500$

This means that Carbon A can be expected to be 2x the performance, capturing more VOCs for longer.

Be sure to buy Carbon A unless it's twice the price, or you wish to refill your cartridges twice as often (it gets tedious quickly!).