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ASCAM Co., Ltd.

Technical Information of CERAMIC CHARCOAL

1. Introduction

Ceramic charcoal is one of the type of charcoal material what has unique and specific features.
Charcoal is well-known material what has various functions, for example, deodorant action, absorption of humidity, trap of small particle and so on.
Ceramic charcoal also has those functions of common charcoal, and has some extra work provided by its different molecular structure.
ASCAM co., Ltd. found its unique feature and got success to manufacture this material by own plant.
This document is to provide the technical information of this unique material as well as suggesting the possible application for improving the living condition of human and animals.

2. What is ceramic charcoal ?

Charcoal material has small size mechanical hole and slit inside and on its surface. The size of hole is distributing from sub-nm to several-10 nm and the width of slit is around 0.5 to 1.0nm. The distribution of the size and number of hole and slit is well affected by the atmosphere and condition of manufacturing process.
The typical function of charcoal such as deodorant action and humidity control is supported by the many amount of mechanical micro-hole and slit. And, the difference of the strength of such function depend on the size-distribution and the number of those micro-holes and slit.
Ceramic charcoal is the one of the type of charcoal, but the size-distribution and number of micro-hole and slit is different from common charcoal.

The manufacturing process of ceramic charcoal was developed by ASCAM.
The process is as follows;
1) grinding the wood (typically Japanese cedar and cypress)
2) add ceramics (made by natural cray) into crashed wood
3) burn in air-controlled chamber at 800 to 850 degree C

The unique size-distribution and number of micro-hole and slit is achieved by above specific manufacturing process.

3. Feature of ceramic charcoal

The feature of ceramic charcoal is mainly defined below 2 function.
a) Selectivity particle absorption
b) Humidity control
Above 2 functions are the feature of common charcoal too, however, ceramic charcoal has more effective and improved work compared with common charcoal.

3-1) Selectivity particle absorption

Common charcoal has excellent action to absorb the micro-particle in the atmosphere, and that behavior is provided by the micro-hole and slit those are usually located on the surface of material. Usually, this action works for most of small particle with various type of molecular structure. Thus, this function is effective to deodorant and to keep the atmosphere (air) clean and fresh.
However, we sometimes hope to eliminate only poisonous particles from air and hope to remain the useful particles in the air. For example, we hope to eliminate V.O.C (volatile organic compounds) but hope to keep preferable flavor such as the flavor of wood.
Ceramic charcoal has this selectivity absorption function shown in table 1 and 2.

Table 1 shows that both ceramic charcoal and activated charcoal have excellent performance to absorb VOC. Both material will absorb more than 90% of VOC material in the air at described conditions.
On the other hand, table 2 shows that ceramic charcoal will absorb only some part of origin material of good flavor while activated charcoal has almost same action to the origin material of good flavor such as pinene and cineol.

Table 1. Absorbed rate of VOC (%)

Material	Absorbed rate (%)		time (hr)
	ceramic charcoal	activated charcoal	
toluene	96	99	5
ethylbenzene	96	99	5
o-xylene	80	93	2
p-xylene	90	94	2
styrene	92	91	2
butyl acetate	96	98	2

Table 2. Absorbed rate of origin of flavor (%)

Material	Absorbed rate (%)		time (hr)
	ceramic charcoal	activated charcoal	
α-pinene	32	98	5
1,8-cineol	29	95	5
limonene	68	89	5

3-2) Absorbing action to different origin materials of flavor

The absorbing action to different origin materials of (human preferable) flavor is served to the measurement.

Table 3 shows the comparison of absorbing action to α-pinene in cypress wood and cedar wood.

Table 3. Absorbed action of ceramic charcoal to wood flavor

Material	original consistency (ppm)	after 24hr exposure (ppm)	
		ceramic charcoal	activated charcoal
α-pinene in cypress wood	143	141	0.04
α-pinene in cedar wood	0.08	0.04	N.D.

(Charcoal is put in 3L of dry air with origin of flavor and kept 24 hr)

The absorbing action to the various type of essential oil is measured too.
We choose 8 different and major materials of essential oil and measure the remaining (survival) ratio according to below formula.

$$\text{remaining ratio (\%)} = (1 - (C_{B5} - C_{S5})/C_{B5}) \times 100$$

C_{S5} is the accumulated amount of the contents of essential oil after 5hr exposure with ceramic charcoal

C_{B5} is the accumulated amount of the contents of essential oil after 5hr static condition (no exposure)

Figure 1 shows the result of this measurement.
We find that the remaining ratio for various essential oil is around 80% except for the case of geranium and rose.

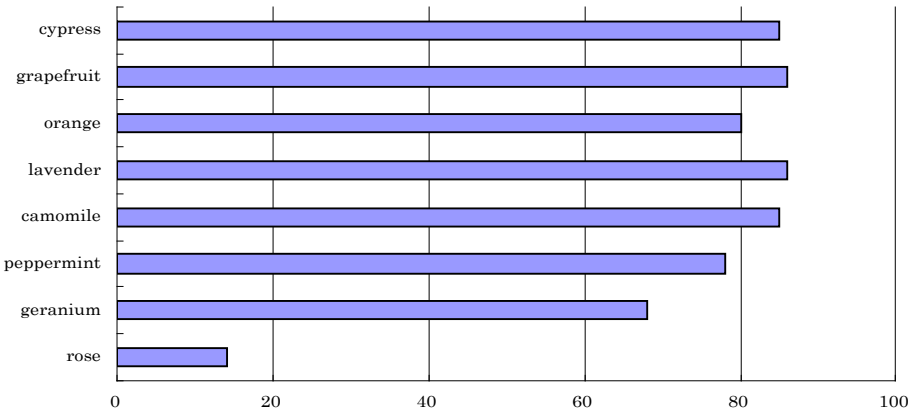


Figure 1. Remaining ratio of the content of essential oil (%)

Table 1, 2, 3 and figure 1 suggest that ceramic charcoal has significant function of selectivity particle absorption.
This material absorbs some typical VOC at almost same level of activated charcoal what is commonly used for deodorant goods. But, ceramic charcoal does not well absorb typical materials of the origin of preferable flavor, such as wood and essential oil, while activated charcoal does absorb these materials.

3-3) Deodorant function of ceramic charcoal

We introduce the unique function, that is selectivity particle absorption, of ceramic charcoal in the last section.
We describe the deodorant function of ceramic charcoal to the other typical materials in this section.

Figure 2, 3 and 4 shows the deodorant performance of ceramic charcoal to 3 different materials, ammonia, formaldehyde and hydrogen sulfide.

Figure 2 ammonia

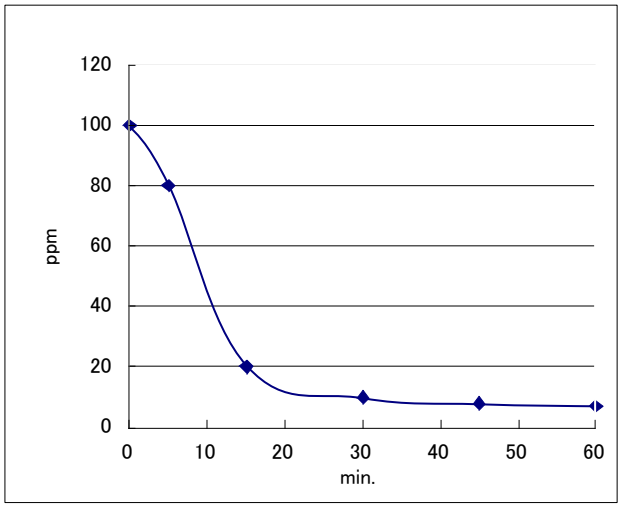


Figure 3 formaldehyde

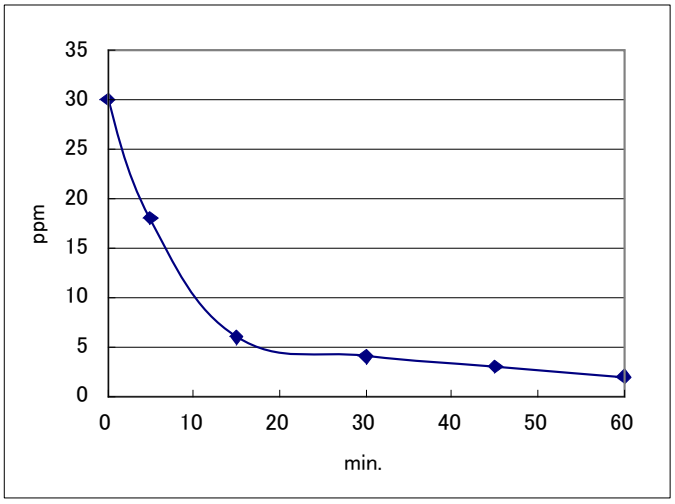
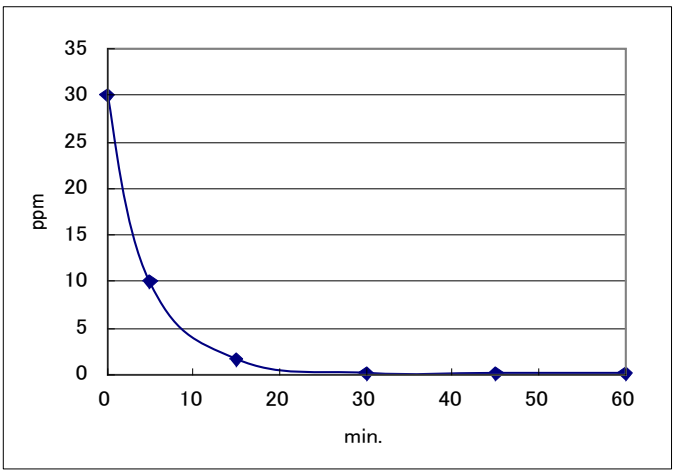


Figure 4 hydrogen sulfide



The measurement condition of figure 2, 3 and 4 is as follow.
Put 3g of ceramic charcoal and tested material in together in 5L plastic bag, measure the ppm value of each material according to the time course.

Figure 5, 6 and 7 shows the comparison of deodorant performance between ceramic charcoal and bamboo charcoal.

Figure 5　Case of acetaldehyde

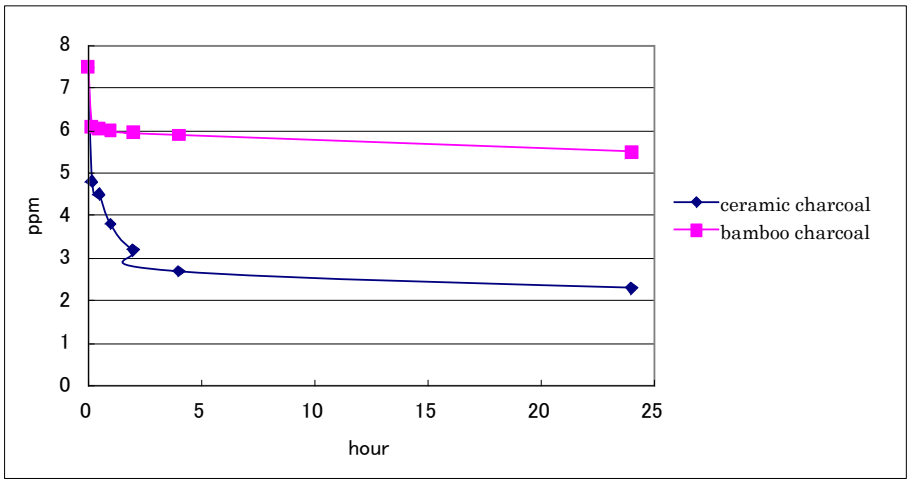


Figure 6　Case of toluene

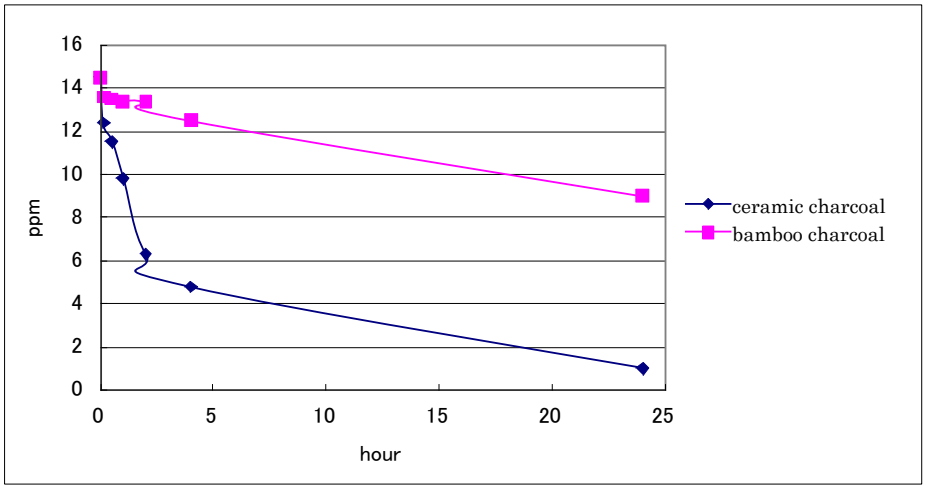
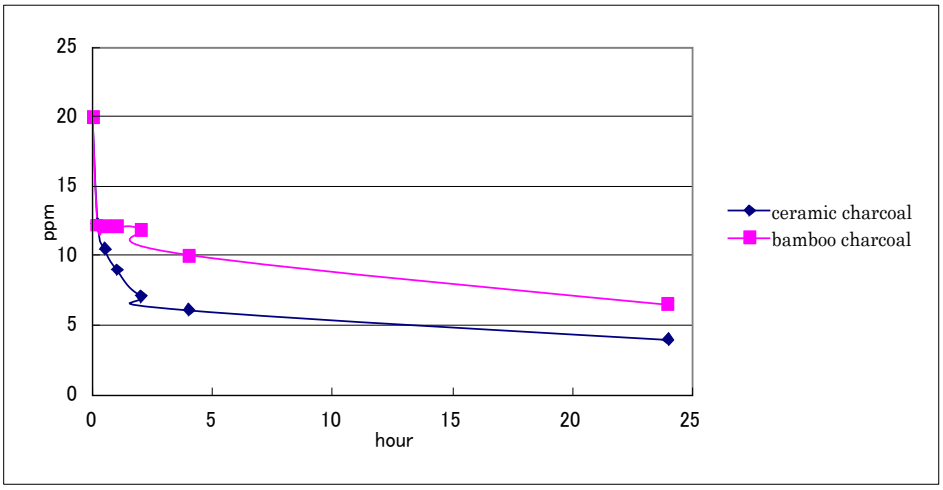


Figure 7　Case of Ammonia

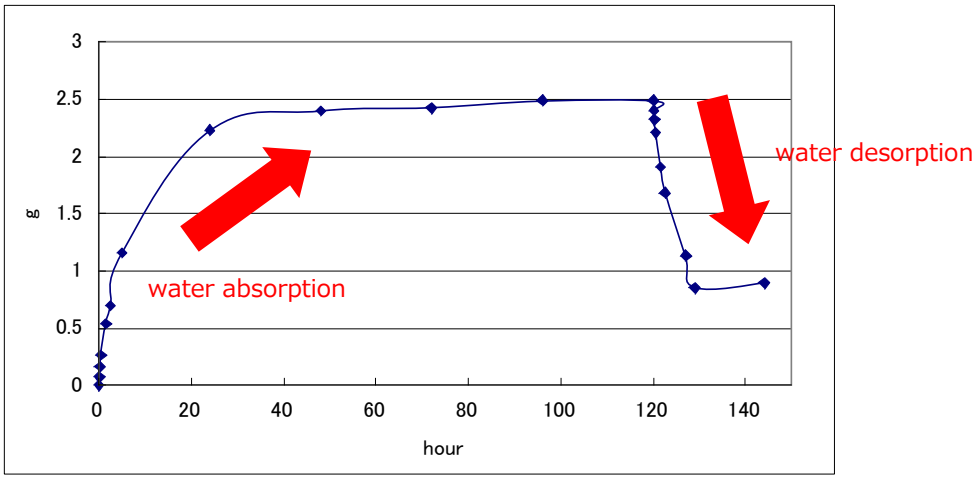


These 3 figures suggest that the deodorant performance of ceramic charcoal is higher than bamboo charcoal what is commonly used as the deodorant goods in Japan.

3-4) Moisture control function of ceramic charcoal

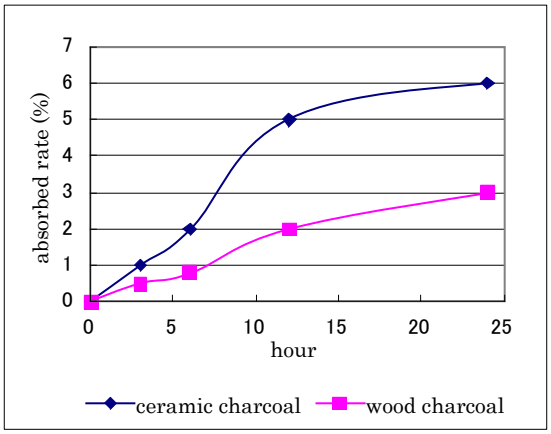
Ceramic charcoal also has unique function of moisture control.
Figure 8 shows the time course behavior of ceramic charcoal.

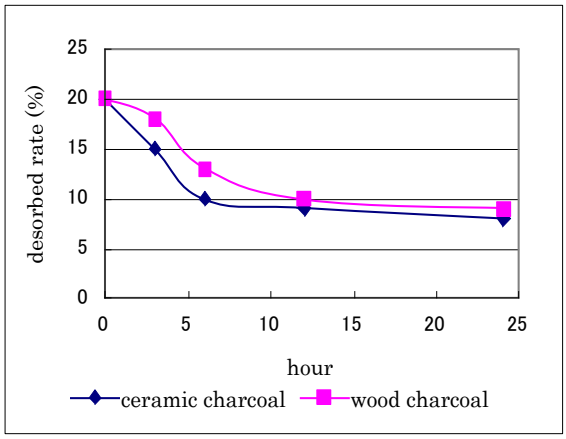
Figure 8 humidity absorbing and desorbing of ceramic charcoal



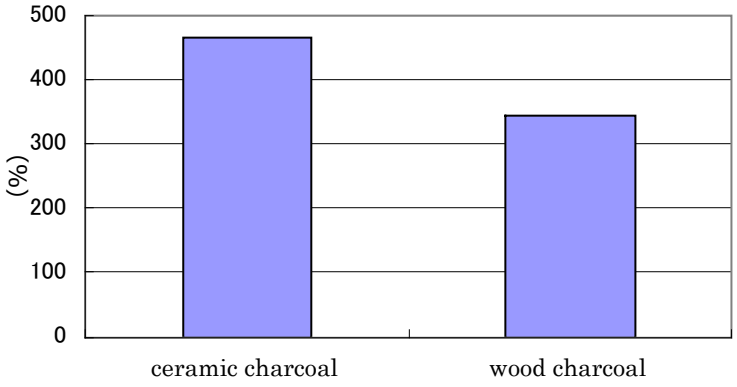
Put ceramic charcoal in the closed box with room temp. and 90% humidity, and measure the value of water absorption. Then, reduce the humidity to 55% after 96 hours and measure the value of water desorption.

Below 2 figures shows the comparison of humidity absorbing and desorbing performance between ceramic charcoal and wood charcoal.





The right figure shows the maximum value of water capturing avility of both ceramic charcoal and wood charcoal.
Since the ceramic charcoal has much more cavity in its body, therefore, it can contain larger volume of water inside than common wood charcoal.



These results suggest that ceramic charcoal has excellent performance of water absorption compared with bamboo and wood charcoal, while it has good performance of water desorption when the humidity of atmosphere comes down.
So, this unique function will be applied for humidity control device with whole natural made.

4. Application