The Preparation and Research of Guhai Rock Water

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ABSTRACT: The Guhai rock which could purify water quality, transform water’s cluster to smaller cluster and release negative ions was a kind of sedimentary rock, and it was found in the Yellow River basin. The Guhai rock was characterized by XRF and SEM. We immersed the additives which made from the Guhai rock into pure water, and then we tested pH value, oxidation-reduction potential, $^{17}$O-nuclear magnetic resonance spectra and number of negative ions of the water.

1 INTRODUCTION

1.1 The Guhai rock

The Guhai rock which belonged to the sedimentary rock was formed in more than 240 million years ago and distributed in the Yellow River basin. The main features of Guhai rock which could be used as containers of water and additives to produce health care products were nontoxic, odorless, and no radiation. 1173 ions/cm$^3$ were the anion releasing efficiency of Guhai rock. As shown in Figure 1, Liesegang Patterns were displayed on the surface of the rock.

![Figure 1. The Photo of Guhai rock.](image)

1.2 The relationship between anion and health

As shown in Table 1, Prof. Li had summarized the 7 levels of the quantity of anions. And the minimum number of anion to maintain human body’s health is 500-1000 ions/cm$^3$. Anion had directly influence on human's central nervous system and blood circulation. It also could im-
prove brain’s function, enhance body’s immunity, boost our metabolism, and eliminate the feeling of fatigue. Therefore, product which could release anions was good for human’s health.

Table 1. The relationship between anion and health.

<table>
<thead>
<tr>
<th>Quantity (ions/cm³)</th>
<th>Level</th>
<th>Relationship</th>
</tr>
</thead>
<tbody>
<tr>
<td>More than 10000</td>
<td>7</td>
<td>self-healing ability</td>
</tr>
<tr>
<td>5000-10000</td>
<td>6</td>
<td>prevent disease</td>
</tr>
<tr>
<td>2000-5000</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>1500-2000</td>
<td>4</td>
<td>Enhance immunity</td>
</tr>
<tr>
<td>1000-1500</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>500-1000</td>
<td>2</td>
<td>keep healthy</td>
</tr>
<tr>
<td>300-500</td>
<td>1</td>
<td>Cause illness</td>
</tr>
</tbody>
</table>

1.3 The relationship between water and health

Water is the source of life and the link that binds all living beings on this planet. The qualities of the water have a strong impact on human's health. Studies have shown that small cluster water with weak alkalinity (pH value was 7-8) and low oxidation reduction potential was good for human’s health.

2 EXPERIMENTAL PROCEDURE

2.1 Preparation of Guhai rock water

The Guhai rock was smashed by using TJH-2-4L multidimensional oscillating nano ball mill, and then a certain amount of the powder was immersed into 500ml pure water. The sample was stirred under ultrasonic wave for 10 minutes and then filtered after the sample stood for a period of time.

2.2 Testing and characterization

Scanning electron microscopy (SEM) images were taken on a cold-cathode field emission scanning electron microscopy (Hitachi-S4800II, Japan), at an accelerating voltage of 10 kV. The sample which was coated with gold for SEM was a piece of rock. The qualitative elementary analyses of Guhai rock were carried out by using an x-ray fluorescence spectrometry (ADVANT X’P-381, Switzerland). The pH value, redox potential and $^{17}$O-nuclear magnetic resonance spectra of the sample were tested by using pH meter (HI4222, China), high resolution nuclear magnetic resonance spectrometer (INOVA-500) and oxidation-reduction potentiometer (ORP-986, China), respectively. The inductively coupled plasma atomic emission spectrometer (SPS8000, China) was used to analyze the trace elements in the sample. And we used air nega-
tive ions counter (DLY-6A-232, China) to obtain the average number of anions which released by the Guhai rock or the sample in the air for about 3 minutes.

3 RESULTS AND DISCUSSION

3.1 The qualitative elementary analyses of Guhai rock

The result of x-ray fluorescence analysis was shown in Table 2.

<table>
<thead>
<tr>
<th>Basis</th>
<th>CaO (%)</th>
<th>MgO (%)</th>
<th>SiO₂ (%)</th>
<th>Al₂O₃ (%)</th>
<th>K₂O (%)</th>
<th>Fe₂O₃ (%)</th>
<th>TiO₂ (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>44.1</td>
<td>23.6</td>
<td>20.6</td>
<td>5.60</td>
<td>2.82</td>
<td>2.59</td>
<td>0.32</td>
</tr>
</tbody>
</table>

As shown in Table 2, the bases of Guhai rock were CaO, MgO, etc. and there were a small quantity of TiO₂. Fe³⁺ ion could become Fe⁵⁺ by oxidation reaction which the TiO₂ as the catalyst. Reaction equation was as follow.

\[
\text{Fe}^{3+} + \text{H}_2\text{O} \xrightarrow{\text{catalyst}} \text{Fe}^{5+} + \text{H}_2\text{O}^- 
\]

3.2 The surface morphology of Guhai rock

The surface morphologies of Guhai rock was observed by SEM in Figure 2. As shown in Figure 2A and Figure 2B, nano-sized pipeline which inner face was smooth was existed on the rock. Therefore, Guhai rock has the property of purify water. Two typical microstructures of Guhai rock were shown in Figure 2C and Figure 2D. One was acerose structure and another was lamellar structure. It has been found that the size of acerose structure has an average width below 50nm and the average thickness of the laminas was below 50 nm.

![Figure 2. SEM images of the Guhai rock.](image-url)
3.3 The mechanism of release negative ions of Guhai rock

Water that enter into the internal rock was ionized because of micro electric field which produced by the two typical microstructures of Guhai rock and the existence of iron ions. As shown in Figure 3, the $\text{H}^+$ got an electronic to generate hydrogen, and the $\text{OH}^-$ combined with a water molecule to generate a hydrated anion.

![Figure 3. Schematic diagram of release negative ions.](image)

3.4 The result of pH value test

The pH value of tap water, natural river water, and Guhai rock water was 5.9, 6.7 and 7.4, respectively. The tap water presented acid because of residue of Cl$_2$ which could form HClO in water. And the pH value of water changed from acidic to alkaline after it processed by Guhai rock. This phenomenon shows that the Guhai rock has adsorption ability.

3.5 The result of redox potential test

The redox potential of tap water, natural river water, and Guhai rock water was 329mV, 244mV and 124mV, respectively. The redox potential of tap water became lower after it processed by Guhai rock. This also explained that the Guhai rock has adsorption ability.

3.6 The result of $^{17}\text{O}$-NMR test

Table 3 showed the 50% linewidth of $^{17}$O-NMR spectrogram of samples which Guhai rock immersed into water for different time. The 50% linewidth showed downtrend along with time, and finally it trend toward a stable value about 55 Hz. Therefore, the Guhai water was small cluster water with 5-7 water molecule clusters.

![Table 3. The 50% linewidth of samples.](image)

<table>
<thead>
<tr>
<th>Time(h)</th>
<th>5</th>
<th>24</th>
<th>124</th>
<th>1200</th>
</tr>
</thead>
<tbody>
<tr>
<td>50% linewidth(Hz)</td>
<td>94.57</td>
<td>75.00</td>
<td>69.70</td>
<td>56.39</td>
</tr>
</tbody>
</table>

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3.7 Anion release performance evaluation of Guhai rock and Guhai water

The anions concentration tests were shown in Figure 4. The average value of anions concentration of Guhai rock and Guhai rock water were -1173 ions/cm$^3$ and -907 ions/cm$^3$, respectively.

![Figure 4. The anions concentration test of Guhai rock (A) and Guhai rock water (B).](image)

3.8 The trace elements concentration

As shown in Table 4, there are many trace elements which required in the human’s body were contained in the Guhai rock water. This result suggested that Guhai rock was suitable for being used to purify water and make the tap water into high quality water.

<table>
<thead>
<tr>
<th>Trace elements</th>
<th>Ti</th>
<th>Mo</th>
<th>V</th>
<th>Ni</th>
<th>Co</th>
<th>Cu</th>
<th>Mn</th>
<th>Sr</th>
<th>Fe</th>
<th>Zn</th>
<th>K</th>
<th>Al</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentration of Guhai water (ppm)</td>
<td>0.013</td>
<td>0.022</td>
<td>0.013</td>
<td>0.011</td>
<td>0.036</td>
<td>0.007</td>
<td>0.006</td>
<td>0.051</td>
<td>0.009</td>
<td>0.062</td>
<td>0.962</td>
<td>0.223</td>
</tr>
</tbody>
</table>

4 CONCLUSIONS

In this paper, we used the Guhai rock to make tap water into high quality water, and the Guhai water had features as follow:

1. The water presented weak alkaline, and the pH value was 7.2-7.8;
2. The redox potential was 124 mV, and the water had antioxidant function;
3. The 50% linewidth of 17O-NMR which indicated the Guhai rock water was the small cluster water was 56.39 Hz;
4. The Guhai water contained many trace elements.
REFERENCES


