THE MAGNETIZATION AND PURIFICATION OF DRINKING WATER BY SPECIAL PURPLE SAND MATERIALS UNDER DIFFERENT FIRING TEMPERATURE

by

Musen LIU [a] ***and Shanxin FENG*** [b*]

[a] College of Art, Qilu University of Technology,
Shandong Academy of Sciences, Shandong, China
[b] Engineering Training Centre, Qilu University of Technology,
Shandong Academy of Sciences, Shandong, China

Original scientific paper
https://doi.org/10.2298/TSCI181117141L

Traditional purple sand has the function of magnetized water quality. This study refers to the characteristics of purple sand and produces a new ceramic raw material with magnetized water quality. In this paper, the key conditions and influencing factors influencing the purple sand making process are studied. The materials involved in the production process are formulated and a new material formulation for ceramic firing is prepared. Ceramic products in the research results can not only improve drinking water quality, but also provide new materials for the field of medical water purification. The application of new materials will improve product quality and reduce production cost.

Key words: *new type of purple sand material, magnetized water, water purification, medical water, firing temperature*

Introduction

Special purple sand is produced by kiln, firing temperature higher than ordinary violet arenaceous, up to 1300 °C, only a few are recommended. Not only beautiful, and after tea, the tea does not corrupt in the pot for the night, use for a long time, even pour boiled water, also can have special purple sand tea color, flavor. In addition the function and the function of magnetized water, special violet arenaceous material containing ferric oxide, ferric oxide via a certain temperature of fire into ferroferric oxide, and have certain magnetic properties and corrosion resistance, in the magnetic environment, bacteria will be negative number, can reduce the bacteria breeding and magnetized water penetration dissolved force is very strong. Use magnetized water to make tea, tea of nutrition will be a large amount of precipitation, the longer the precipitates, the more scientific research shows that the magnetized water for cell absorption rate, up to 30 times mineral water absorption rate, magnetized water can help promote biological neural tissue metabolism, can promote cell biological activity, this is the opposite of tap water [1-3]. After magnetization treatment of natural water of tap water, the microbial content in water can be reduced by 81-97%. Use magnetized water to clean the wound, have the effect of sterilization, the wound healing quickly [4, 5].

[*] Corresponding author, e-mail: shanxinhh77@163.com

Special purple fire traditional way is to use a special kind of purple sand slurry material is fired, but clay material formula and firing technology has lost years, only to see several his works in the museum of modern methods of fire usually by wu baked black ash technology, or through synthetic sludge fired, namely manganese iron is added in the sludge metal oxide as coloring agent, such as synthetic material calcined products easy exhalationxic mud is not easy to use for a long time, so the use of natural clay preparation new mud compound has certain advantages, for one, is a natural mineral ingredients, no added toxic chemicals, safety performance [6-8].

Secondly, the clay can be burned at high temperature, and it will not produce sintering phenomenon due to improper firing method [9]. The clay is flexible, and the finished product is beautiful, which increases the aesthetic value of the product.

Methodology

Due to special violet arenaceous raw material is difficult to obtain, fire system is difficult to control, so the use common clay to replace the special purple fire products are able to increase the quantity of fungicide were adsorptionxic substances in the solution in the sterilization of the reason is that its finished product ferroferric oxide and ferroferric oxide is made up of ferric oxide in the material transformation, it is also known as black iron magnet for magnets, the substances dissolved in acid solution Insoluble in water and alkali solution.

Been scientifically tested shows special purple fire product contains 6.6% ferroferric oxide, the content of ferric oxide is key to the success of new ceramic material preparation The chemical formula which best characterizes the known both under the condition of heating:

$$6Fe_2O_3 = \triangle = 4Fe_3O_4 + O_2\uparrow \tag{1}$$

Therefore, the ratio of trioxide in the new ceramic materials is calculated, and the generation X g trioxide is required to consume Y g trioxide, which is obtained by the law of conservation of mass:

$$Y = X + \frac{X}{29} \tag{2}$$

where X = 6.6, known solutions of Y = 6.828, so the preparation of new ceramic materials must join 6.828% ferric oxide Clay weighing in ferric oxide powder and use vacuum pug mill of refining, fire experiments Fire, after the completion of the products to a functional test. The composition of the special purple sand is listed in tab. 1. The results of chemical composition analysis and its proportion in the special purple sand is listed in tab. 2.

Table 1. The composition of the special purple sand

Scale Component name	Percentage [%]
Red kaolin	20
White kaolin	20
Bian-stone powder	10
Tuogou clay/Native clay	30
Feldspar	15
Quartz	5

Table 2. The results of chemical composition analysis and its proportion in the special purple sand

Chemical weight / Name	The proportion of each chemical composition in the special purple sand [%]	Specific gravity of chemical components of the special purple sand in new needle stone ceramic materials [%]
$CaCO_3$	96.17	9.617
MgO	0.67	0.067
SrO	0.43	0.043
Fe_2O_3	0.46	0.046
SiO_2	0.88	0.088
TiO_2	0.45	0.045
Na_2O	0.89	0.089
K_2O	0.05	0.005

Results and discussion

Although Fe_2O_3 is transformed into Fe_3O_4 when heated, it is converted to FeO in a reductive atmosphere, because the kiln is in a closed state. When the fuel consumes the oxygen in the furnace, will absorb oxygen from the fetus, CO will absorb the oxygen in the Fe_2O_3 to produce FeO.

Therefore, the kiln atmosphere should be strictly controlled and the oxidation atmosphere should be maintained when firing new ceramic materials.

Effect of heating curve on PH value in water

Instrument: PH-meter; measuring range 0-14PH; Model: MT-5000.

The experimental condition variable for heating is: 20 °C, 40 °C, 60 °C, 80 °C, and 100 °C.

It can be seen that as the temperature rises, the pH of the water in the special purple sand container rises slowly, as shown in fig. 1.

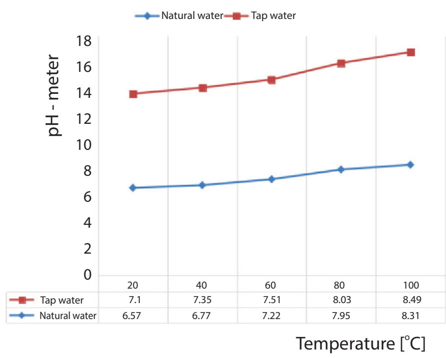

Figure 1. Heating curve and PH value

Effect of heating curve on yield of finished products

Record the product yield rate of different temperatures, 100 units per kiln. As can be seen from the fig. 2, the optimum firing temperature is around 1300 °C, and the upper and lower sections are not more than 10 °C.

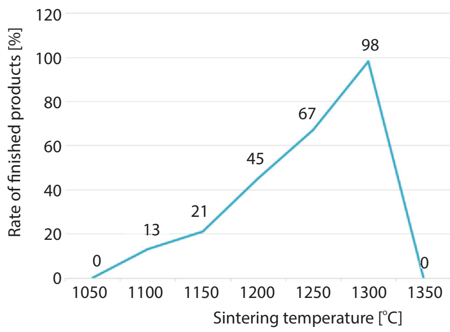

Figure 2. The relationship between the temperature of the kiln and the rate of finished products

Effect of using magnetic water tea on the number of heterotrophs in water

Culture medium

Culture medium composition and culture environment shown in tab. 3.

Table 3. Culture medium composition and culture environment

Name	Ingredient	Culture temperature [°C]	Incubation time [*d*]
Culture medium	Beef extract AGAR Peptone NaCl	38	7

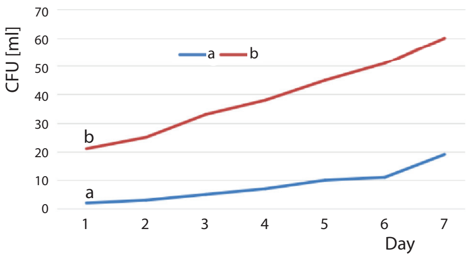

Figure 3. Effect of magnetized water on the number of heterotrophic bacteria

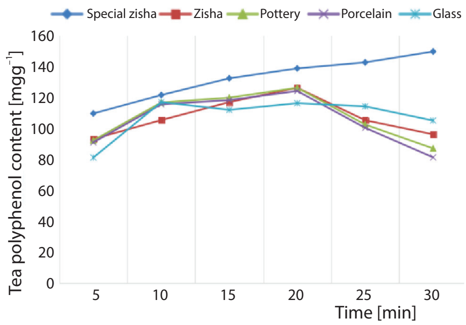

Figure 4. Precipitation of tea polyphenols in different containers

Water samples: new type of ceramic material sample water (a)
ordinary glass container bubble sample water (b)

Effect of magnetized water on the number of heterotrophic bacteria can be seen in fig. 3, In a period of one week, the water from the special purple sand, the number of heterotrophic bacteria in the water is much less than ordinary water.

The precipitation of tea polyphenols in different containers

Raw material: 4 g tea samples, green tea, 200 mL second distilled water.

The water temperature: 100 °C.

The tea polyphenol content of five kinds of different materials was observed. It was found that the content of tea polyphenols in the tea water brewed by the new ceramic material was very high compared with other utensils, and tea polyphenols in other utensils were also found in other utensils, as shown in the fig. 4.

Drinking the health of the volunteers by the special purple sand

Experimental materials: 20 g special purple sand, volume 200 mL.

The experimental group extracted six special purple sand containers and analyzed the precipitation of trace elements at different temperatures. The data of each group are shown in tabs. 4-9. It will make a great contribution to the change of water quality, provide people with healthy, weakly alkaline water, solve drinking water problems and reduce the prevalence rate.

Table 4. Drinking the health of the volunteers by the special purple sand group I

Time / Element	40 °C	60 °C	80 °C	100 °C
Ca	2.0785	3.9874	4.2861	5.1828
Fe	0.0022	0.0034	0.0045	0.0109
K	0.0340	0.0560	0.0980	0.1209
Mg	0.0320	0.0487	0.0890	0.1009
Na	0.0599	0.1040	0.1115	0.2056
Si	0.1101	0.1231	0.1475	0.1634
Sr	0.0087	0.0176	0.0346	0.0399
Ti	D. L.	–	–	–

Table 5. Drinking the health of the volunteers by the special purple sand group II

Time / Element	40 °C	60 °C	80 °C	100 °C
Ca	2.2877	3.4556	4.4590	5.3928
Fe	0.0053	0.0060	0.0090	0.0288
K	0.0644	0.0792	0.1452	0.1678
Mg	0.0544	0.0782	0.0885	0.1202
Na	0.0728	0.1320	0.1930	0.3288
Si	0.0130	0.1350	0.1305	0.1598
Sr	0.0091	0.0270	0.0376	0.0378
Ti	D. L.	–	–	–

Table 6. Drinking the health of the volunteers by the special purple sand group III

Time / Element	40 °C	60 °C	80 °C	100 °C
Ca	3.2357	4.4553	5.4501	5.3944
Fe	0.0046	0.0058	0.0088	0.0256
K	0.0635	0.0777	0.1050	0.1188
Mg	0.0644	0.0792	0.1452	0.1678
Na	0.0226	0.0367	0.0898	0.1277
Si	0.0745	0.1355	0.1917	0.3287
Sr	0.0130	0.1350	0.1305	0.1598
Ti	D. L.	–	–	–

Table 7. Drinking the health of the volunteers by the special purple sand group IV

Time / Element	40 °C	60 °C	80 °C	100 °C
Ca	3.2645	4.4542	5.4503	5.3944
Fe	0.0040	0.0077	0.0089	0.0256
K	0.0630	0.0771	0.1002	0.1179
Mg	0.0544	0.0782	0.0885	0.1202
Na	0.0728	0.1320	0.1930	0.3288
Si	0.0145	0.1388	0.1367	0.1512
Sr	0.0085	0.0201	0.0345	0.0353
Ti	D.L.	–	–	–

Table 8. Drinking the health of the volunteers by the special purple sand group V

Time / Element	40 °C	60 °C	80 °C	100 °C
Ca	3.2833	4.4583	5.4570	5.3990
Fe	0.0045	0.0038	0.0077	0.0291
K	0.0689	0.0756	0.1081	0.1182
Mg	0.0592	0.0728	0.0892	0.1290
Na	0.0793	0.1337	0.1919	0.3203
Si	0.0140	0.1336	0.1330	0.1591
Sr	0.0055	0.0266	0.0323	0.0389
Ti	D. L.	–	–	–

Table 9. Drinking the health of the volunteers by the special purple sand VI

Time / Element	40 °C	60 °C	80 °C	100 °C
Ca	3.2863	4.4590	5.4583	5.3946
Fe	0.0088	0.0077	0.0020	0.0202
K	0.0692	0.0783	0.1040	0.1129
Mg	0.0503	0.0767	0.0892	0.1230
Na	0.0702	0.1382	0.1930	0.3240
Si	0.0190	0.1319	0.1348	0.1572
Sr	0.0073	0.0203	0.0355	0.0329
Ti	D. L.	–	–	–

Conclusion

According to the analysis of experimental data, natural water and tap water are used to soak water through new ceramic materials, respectively. Among them, the tap water has a higher PH value because tap water purified by itself is weakly alkaline. The standard pH value of ordinary tap water is between 6.5-8.5, but the actual measurement of household water is only about 7.1-7.2.

It can be seen from the experimental data that the PH of the soaking water using the new ceramic material is obviously improved. Through the observation of the heating curve and yield, it was found that the optimal firing temperature was between 1280-1300 °C.

In *Experiment 3*, comparing the amount of heterotrophic bacteria in new ceramic materials and ordinary glassware, it was found that the content of heterotrophic bacteria in ordinary glassware was 2.1-9.5 times more than that of new ceramic materials. It can be seen that the new material can inhibit the growth of heterotrophic bacteria, keep the water fresh.

In *Experiment 4*, the tea polyphenol content of five kinds of different materials was observed. It was found that the content of tea polyphenols in the tea water brewed by the new ceramic material was very high compared with other utensils, and tea polyphenols in other utensils were also found in other utensils.

The amount of precipitation gradually decreases after a certain brew time, and the content of tea polyphenols in the new material is proportional to the time.

Acknowledgment

Special thanks for: Key Subjects of Art Science in Shandong Prowince (CZ1710007), Cultural and Educational Social Science Research Project of Shandong Province (11CWYJ14), The General Project of the Social Science Planning Research Project of the Ministry of Education (12YJA760037), Cultural and Educational Social Science Research Project of China, (SDYC13039), Cultural and Educational Social Science Research Project of Shandong Province, (4CWYJ27), Education Quality Improvement Project of Shandong Graduate Student, The Key Project of Art Science in Shandong Province (201706337), Cultural and Educational Social Science Research Project of China, (17YJC760042).

References

[1] Nazeer, W. A., *et al.*, *In-situ* Species, Temperature and Velocity Measurements in a Pulverized Coal Flame, *Combustion Sciences and Technology*, *2* (1999), 143, pp. 63-77
[2] Suhas, V. K., *et al.,* Cellulose: A Review as Natural, Modified and Activated Carbon Adsorbent: Biomass, Bioenergy, Biowastes, Conversion Technologies, Biotransformations, Production Technologies, *Bioresource Technology*, *216* (2016), Sept., pp. 1066-1076
[3] Ostroumov, S. A., Water Quality and Conditioning in Natural Ecosystems: Biomachinery Theory of Self-Purification of Water, *Russian Journal of General Chemistry*, *13* (2017), 87, pp. 3199-3204
[4] Sultana, R., *et al.*, Thermal Properties of Porcelain Reinforced Polyester Resin Composites, *Bangladesh Journal of Scientific and Industrial Research*, *2* (2017), 52, pp. 147-152
[5] Regti, A., *et al.*, Use of Response Factorial Design for Process Optimization of Basic Dye Adsorption onto Activated Carbon Derived from Persea Species, *Microchemical Journal*, *130* (2017), Jan., pp. 129-136
[6] Liu, X., *et al.*, An Ecological Engineering Pond Aquaculture Recirculating System for Effluent Purification and Water Quality Control, *CLEAN–Soil, Air, Water, 3* (2014), 42, pp. 221-228
[7] Chen, D., *et al.*, Production and Pre-Oxidation of the Activated Carbon Fibre Needle Felt Using in the Prevention and Control of Water Pollution, *Desalination and Water Treatment*, *122* (2018), Aug., pp. 211-214
[8] Wang, Y., Yixin, Z., Functions of Chitin Fibre in Water Pollution Control, *Desalination and Water Treatment*, *122* (2018), Aug., pp. 192-194
[9] Wang, Y., *et al.*, Green Textile Materials and Techniques for Water Resource Protection, *Desalination and Water Treatment*, *122* (2018), Jan., pp. 195-198

Paper submitted: November 17, 2018
Paper revised: January 15, 2019
Paper accepted: January 20, 2019