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Discussion

Reply to the discussion by Ayhan Demirbas of the paper "Study on the pozzolanic properties of rice husk ash by hydrochloric acid pretreatment"☆

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The authors are grateful to Prof. A. Demirbas for his interesting discussion about our paper and for their comments, which we find many of them are helpful.

The present work is a part of the comparative study on the effect of hydrochloric acid pretreatment and heating course on the properties of rice husk ash.

We agree with the comment that the chemical effects of pozzolanic materials on crystal formation and developing during the hydration should be expanded. It is well known that the chemical properties of rice husk ash depend upon its silica form and specific surface. In the paper, we had showed the effect of silica form and specific surface of rice husk ash on the pozzolanic materials. We add some results of pore size distribution of rice husk ash measured by using the method of Dollin/Head, and the effect of hydrochloric acid pretreatment on porosity of the rice husk ash also shows in the reply.

The pore distribution of rice husk ashes is showed at Fig. 1. The pore distribution, pore specific volume and monolayer volume are also given in Table 1, respectively. The predominant type of pores is found to be mesopores (for RHA) or mesopores and micropores (for ADR). The pore radius is mainly between 1 and 10 nm, with an average radius of about 2 nm. For ADR samples heated rice husk between 600 and 800 °C, the pore distributions are bimodal: two maximums at 1.29 and 1.86 nm, respectively. But an isotherm for ADR heated at 900 °C is one-humped (1.86 nm), which corresponds to the lower surface area (145 $m^2 \cdot g^{-1}$). The isotherms for the RHA samples are one-humped (1.86 nm), and the peak of an isotherm for RHA heated at 900 °C disappear, which corresponds to the lowest surface area (9.24 $m^2 \cdot g^{-1}$). The results above show that the pore distribution of silica in either ADR samples or RHA samples has a great change by the hydrochloric acid

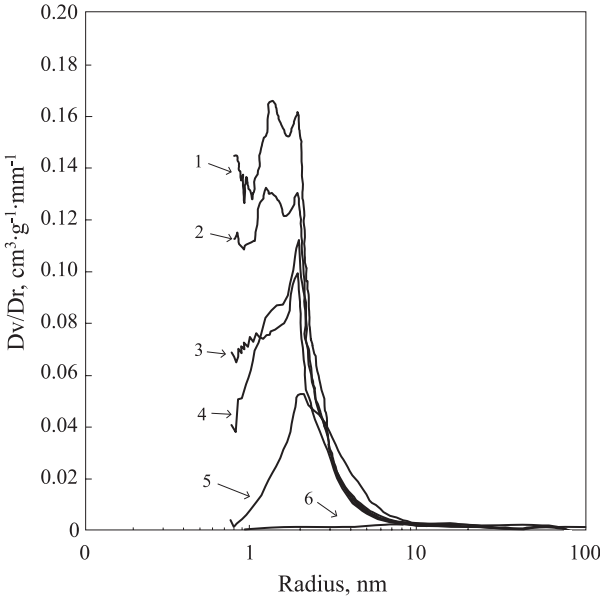

Fig. 1. Pore distributions of rice husk ash determined by N_2 isothermal adsorption and desorption. 1-ADR, 700C; 2-ADR, 800C; 3-ADR, 900C; 4-RHA, 500C; 5-RHA, 600C; 6-RHA, 800C; kept for 4 hours at the ashing temperature.

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Table 1
Pore distribution and pore volume of rice husk ash obtained from different treatment conditions

Sample	Ashing temperature, °C	Treated condition	Pore distribution (radius)			Specific surface area, $m^2 \cdot g^{-1}$	Pore specific volume, $cm^3 \cdot g^{-1}$	Monolayer volume, $cm^3 \cdot g^{-1}$
			Macropores	Mesopores	Micropores			
			>50 nm	2–50 nm	<2 nm			
RHA	500	untreated	25.00	55.51	19.49	142	0.31	32.68
	550	untreated	20.41	53.77	25.82	164	0.32	37.70
	800	untreated	59.71	40.29	0	9.24	0.09	2.12
ADR	600	1 N HCl, 4 h	12.60	46.84	40.56	270	0.37	62.08
	700	1 N HCl, 4 h	15.81	48.4	35.79	311	0.43	71.46
	700	3 N HCl, 4 h	26.79	38.99	34.22	251	0.39	57.63
	800	1 N HCl, 4 h	23.55	46.31	30.14	257	0.34	59.03
	900	1 N HCl, 4 h	27.22	44.3	28.47	145	0.29	33.23

Kept for 4 h at the ashing temperature.

pretreatment and the heating course, and that, the pore distribution of rice husk ash affects the chemical reactivity of rice husk ash as a pozzolanic material. As an agricultural waste material, many unique properties of rice husk ash had been studied. But serious questions in the area of material remain to be answered. Much more experimental verifications are needed to carry out. It is expected that a better rice husk ash product will be available in the future.