

A Study on the Improvement of Characteristics of AC Contactor by Addition of Rare Earth Element

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ARTICLE INFO

ABSTRACT

In the prior literature, to improve the characteristics of the AC contactor, the structural dimension of the contact point was changed or the type of contact material was changed.

This section introduces a method of improving the characteristics of contact including contact resistance and electrical wear by adding a rare earth element to the Ag-Cd0 contact point, which is currently used as an AC contactor.

Keywords:

AC Contactor
Rare Earth Element

1. MAIN CONTENT

Contact specimens for AC contactors were prepared using Ag powder, Cd powder, and rare earth intermediate alloy powder.

The properties of the powders used as raw materials are given in Tables 1 to 3.

Table1. Properties of Ag Powder

Signification	Ag, % or more	Impurities, % below					Average particle size, μm	Surface density, 10^3kg/m^3
		Mo	Ni	Fe	S	P		
Ag-1	99.5	0.12	0.01	0.2	0.02	0.02	4	2.3

Table2. Properties of Cd Powder

Signification	Cd, % or more	Impurities, % below						Average particle size, μm	Surface density, 10^3kg/m^3
		Fe	Co	Cu	C	S	Si		
Cd	99.5	0.2	0.05	0.08	0.02	0.01	0.03	5	4.0

Table3. Characteristics of rare earth intermediate alloy powder

Signification	Alloy composition, %						Average particle size, μm
	Ce	Cu	Fe	Pb	As	Sb	
rare earth intermediate alloy	38	61.5	0.03	0.04	0.005	0.01	4

The mixing of the powder materials was conducted in an alcohol medium for 10 hours, dried and then molded at a pressure of 500 MPa to a diameter of 6mm and a thickness of 3mm.

The rare earth element for the contact alloy is pulverized and the rare earth intermediate alloy is added so that the

rare earth element amount is 0.01, 0.02, 0.03, 0.04, 0.05%, and the mixing and molding process is performed. As the electrical contact sintering device, the switch type AC resistance welding machine of the electromagnet pressurizing device is used.

The technological characteristics of the electrical contact sintering device are shown in table 4.

Table4. Technical Characteristics of Electrical Contact Sintering Equipment

Transformer capacity	Pressure control ranges	Current control range	Time range
70kVA	10~30MPa	8~14kA	30~50

The internal oxidation temperature is guaranteed at 750 ± 10 °C and oxidized for 72 hours in the electric furnace.

In the spot welder, the silver solder dissolved toward

the Ag surface solders the contact eggs uniformly at the bottom of the contact and the plate water.

The compositions of silver and silver-lead solvents are given in Tables 5 and 6.

Table5. Composition of Silver Lead Materials

Silver Lead Materials	Ag	Cu	Zn	Cd
Lead AgCuZnCd	35	35	25	5

Table6. Composition of Silver lead solvent

Ingredient	Content %
Anhydrous borax	35
Anhydrous fluoridation kalium	42
Boron Folic Acid	23

The amount of electrical wear was measured with an electrical wear meter under the conditions of voltage

220V, current 10 ~ 25A, opening time 104 time, and contact pressure 1 000N (Table 7).

Table 7 Measurement results of electrical wear according to the amount of rare earth element added

MR additive amount, %		0.01	0.02	0.03	0.04	0.05
Electrical abrasion amount ΔG , mg	10A	0.8	0.65	0.5	0.5	0.5
	15A	1.1	0.75	0.65	0.63	0.63
	20A	1.3	0.9	0.7	0.7	0.7

Table 7 shows the measurement results of the electrical wear according to the amount of rare earth element added under the sintering current $I = 10$ kA, the

electrode pressure $P = 25$ MPa, and the electrical contact sintering condition with the current passing time $T = 45$ cycles.

As shown in Table 7, the addition of rare earth elements greatly reduces the electrical wear of the contacts.

In other words, when the rare earth element is added up to 0.03% at a current of 10A, electrical wear decreases from 1.0mg to 0.5mg.

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Acknowledgements

The authors wish to thank Mr. RI who gave us much valuable helping in the early stages of this work.

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