JCSE The Journal of Corrosion Science and Engineering

21st Century Corrosion Science

Volume 6 Paper C132

GALVANIC CORROSION OF 27SiMn COUPLED WITH ANTHRACITE IN A MINE WATER

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Abstract. This paper investigates the galvanic corrosion of 27SiMn coupled with anthracite in a mine water. The results show that 27SiMn is anode, anthracite is cathode and anthracite accelerates the oxidation of cathode and quickens the corrosion of 27SiMn.

Key words. 27SiMn; anthracite; electrochemical corrosion

INTRODUCTION

In the environment of coal mine, the electrical characteristics of anthracite accelerates the corrosion of structural materials. 27SiMn(0.24～0.32%C,1.10～1.40%Si,1.10～1.40%Mn) is one of the main structural materials used under pit in China. In the pit of anthracite, the severe corrosion of hydraulic prop which is imbedded in the coal is a primary factor that causes prop hydro-cylinder useless. In this paper the properties of galvanic corrosion of 27SiMn with anthracite are studied. It provides important foundation data for the corrosion prevention of structural materials used in coal mine.

EXPERIMENTAL METHOD

Fig.1 shows the sample used in galvanizing corrosion test. Anthracite (cathode) is cubic with one side exposed. 27SiMn acts as anode. The pH level of the mine water is 7.0～7.4.

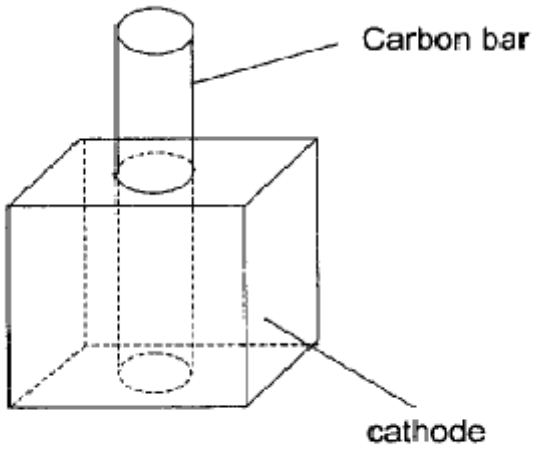

Fig .1 Anthracite sample

EXPERIMENTAL RESULTS AND DISCUSSION

By chemical analysis, we got the following ion concentration(mg/L) in the mine water: 15~28 Cl^-, 59~190 SO_4^{2-}, 226~396 HCO_3^-, 18~36 $K^+ + Na^+$, 18～35 Mg^{2+}, 65~137 Ca^{2+} . The content of C in absolutely dry anthracite matrix is more than 90%.

Because there is a great difference between free corrosion potentials of 27SiMn and anthracite in mine water, the contact of 27SiMn and anthracite leads to galvanic corrosion and the corrosion rate of 27SiMn is accelerated.

The variation of free corrosion potential as time goes on and the polarization test result of electrokinetic potential of 27SiMn in a mine water reveal that the free corrosion potential of 27SiMn is –720mV/SEC in steady state while the free corrosion potential of anthracite is nearly +155mV/SEC in the same condition. 27SiMn becomes the anode when it gets into anthracite because its free corrosion potential is remarkably lower than that of anthracite.

Cathode-anode area ratio (CAAR) exerts a great influence on galvanic corrosion. Greater cathode-anode area ratio accelerates galvanic corrosion. It can be illustrated by the relation of corrosion potential and corrosion current versus time under different area ratio of 27SiMn and cathracite. According to the experimental results, when the areas of cathode and anode are of the same, the steady potential of galvanic couple is approximately –650mV/SCE. It is 180mV more than free corrosion potential of 27SiMn. The variation of galvanic current with time is as follows: When the areas of the two electrodes are of the same, the current density of galvanic couple decreases exponentially with time greatly. The current density is 50 μ A/cm^2 in steady state (an hour later after the two contacting with each other). When CAAR=2, the galvanic current density decreases linearly with time. The falling rate is absolutely lower than that of the former condition. When CAAR=3, the variation of current density with time is more complicated. We can see, when CAAR=3, current density varies without obvious single regular. And an hour later the current density reaches up to about 480

μ A/cm^2.The result of the electrokinetic potential polarization test displays that the free corrosion current density of 27SiMn in mine water is 31.6 μ A/cm^2 when it is not coupled with anthracite. The corrosion of 27SiMn in a mine water is greatly accelerated with the increasing of CAAR when coupled with anthracite

Fig. 2 to Fig .5 show the experimental results of electrochemistry under a variety of conditions.

CONCLUTIONS

Mine water is neutral solution. During the corrosion of 27SiMn, oxygen is released at cathode. Once 27SiMn contacts with anthracite, anthracite becomes an indefinitely great cathode area which effectively weakens cathodic polarization, promotes oxygen releasing at cathode and accelerates the corrosion of 27 SiMn.

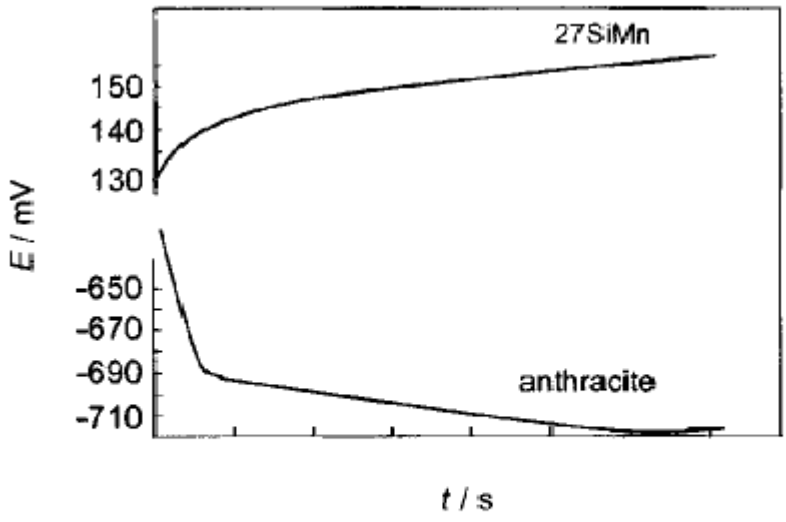

Fig. 2 Free corrosion potenfial versus time for 27Si Mn and anthracite in a mine water

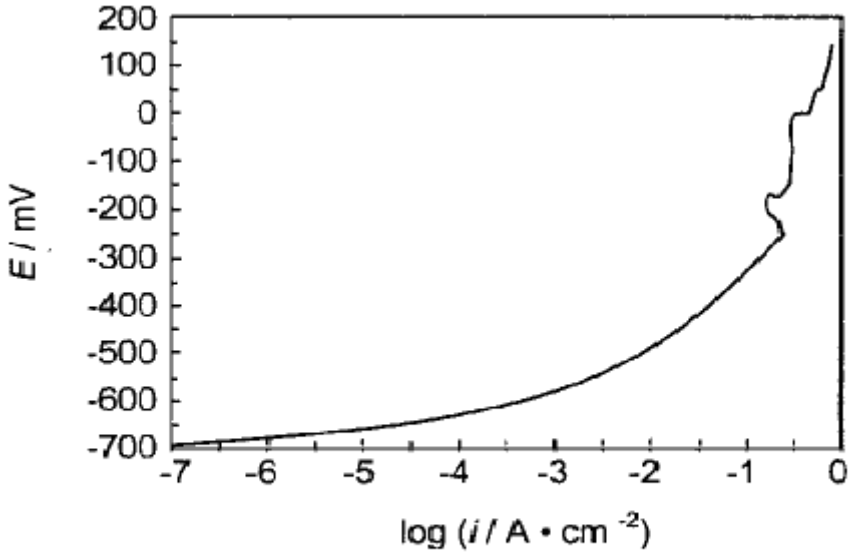

Fig.3 Plarization curve of 27Si Mn in a mine water

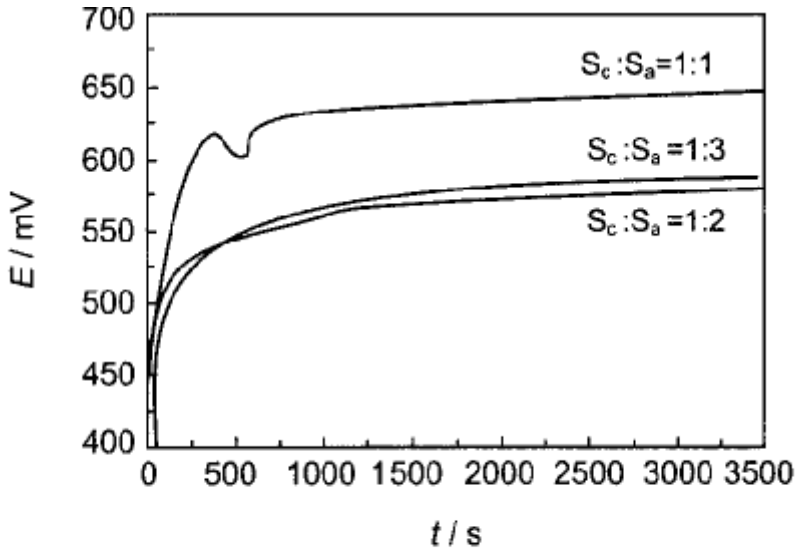

Fig.4 Corrosion potential versus time of couple of 27Si Mn and anthracite with different surface ratio

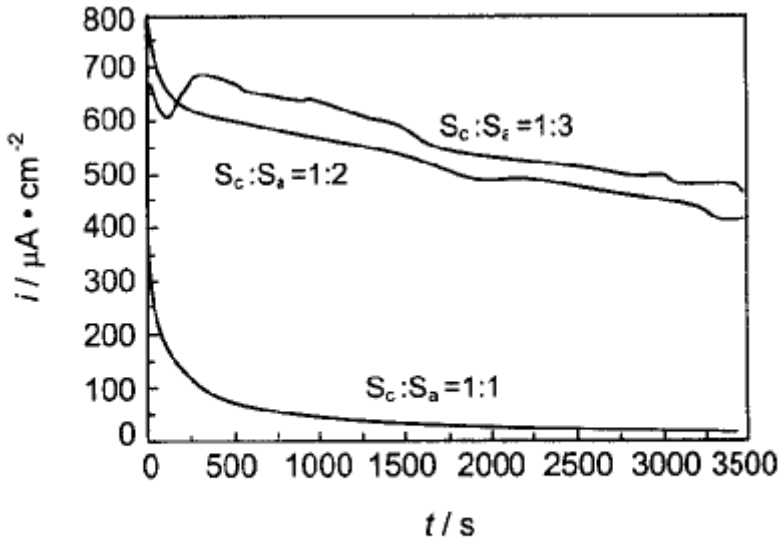

Fig.5 Couple current verses time

REFERENCES

1. Cao Chunan. Corrosion electrochemistry. Journal of chemistry industry,1994.59
2. Song Shizhe. Study methods of corrosion electrochemistry. Journal of chemistry industry,1988.66