A study on organic coating SRB resistance evaluation method in laboratory

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Abstract: Sulfate-reducing bacteria, a kind of anaerobic bacteria fed on organics, widely lies in earth, sea, river, underground pipeline, oil and gas well, etc. Until now, the coating resistance of anaerobic bacteria SRB has not been specified. Based on other reference criteria and laboratory detailed test, a simple evaluation procedure on organic coating resistance of SRB is designed. By the confirmation of laboratory examination, the procedure not only can evaluate different coating resistance performance of SRB, but also can distinguish their performance quality.

Key words: Sulfate-reducing bacteria(SRB)、organic coating、resistance SRB、laboratory evaluation procedure

1. PREFACE

SRB (sulfate-reducing bacteria), a kind of anaerobic bacteria fed on organics, widely lies in earth, sea, river, underground pipeline, oil and gas well, etc. Especially in petroleum production system, SRB not only widely lies, but also greatly reproduces under anaerobic condition, which accelerates scale forming and blocks water injection line. Moreover, in the process of SRB reproducing, part corrosion occurs, severely forms a hole in pipeline, which brings great economic loss to petroleum production. Currently, the main method to prevent SRB corrosion is uninterrupted adding bactericide, wasting a lot of money.

Another economic method is using inner anti-corrosion coating to decelerate SRB corrosion on pipeline, meanwhile continuously adding bactericide is necessary. Now the tendency of anti-corrosion coating is compound function, i.e., combine coating resistance with bactericide initiative restrain to prevent SRB corrosion. The study on compound function coating has been carried on by several research institutes, but how to evaluate organic coating SRB resistance performance by a scientific method is still a prevalent technical question. Currently most institutes use coating mildew resistance performance evaluation method to test coating SRB resistance performance. However the difference between mildew and SRB is really great, mildew belongs to aerobic bacteria while SRB belongs to anaerobic bacteria, so the evaluation result is not scientific. Therefore the study on organic coating SRB resistance evaluation method in laboratory is necessary.

A new organic coating SRB resistance evaluation method in laboratory is introduced in this paper.

Many kinds of coating SRB resistance performance is evaluated by this method and the practical application results confirm its accuracy. Moreover, the tiny gap among different coating SRB resistance performance can also been discovered by this method.
2. EVALUATION METHOD

2.1 SRB collection and cultivation

Separate SRB from waste water of domestic oilfield and purify it until SRB test shows masculine, then put it into bacterial bottle for further use. Dilute one share SRB liquid by 100 share culture liquid, then put it into 250ml cone bottle and culture this bottle in thermostatic oven at 35±1℃. Select high activity SRB liquid which turns into black in 24 hours and inoculate again by the same ratio, then put it in refrigerator for further use.

2.2 coating SRB resistance test in laboratory

Referring to QB/T2591-2003 《antibacterial plastics-antibacterial performance test and effect》, Japanese industrial criteria JIS Z2801 《antibacterial product antibacterial effect and activity evaluation method》 and petroleum criteria SY/T0532 《oilfield water injecting bacteria analysis method》, the coating SRB resistance evaluation method in laboratory is designed as following.

2.2.1 preparation of antibacterial coating sample

The sample is made by normal low carbon steel with the size of 65x15x1.5mm. Brush both sides and the edge with antibacterial coating. The sample is prepared after coating solidifying.

2.2.2 antibacterial performance evaluation procedure

A: Put the sample into 60ml wide necked bottle and make it slanting in the bottle.
B: Pore the former SRB culture medium until it submerges the sample, reaching bottle neck.
C: Inoculate 1ml SRB liquid with known bacteria quantity.
D: Fully shake the bottle after covering the top and put it in thermostatic oven at 35±1℃ for 7 days.
E: After culturing for 7 days, test SRB content in culture medium which close to the sample as N (unit/ml) by SRB testing bottle method and test SRB content in the blank sample as M (unit/ml).
F: Calculate bactericidal ratio by the formula as following.

\[ \text{Bactericidal ratio} = \frac{M-N}{M} \]

G: Test at least 2 group parallel samples and the blank samples simultaneously.

Some culture medium turns into black after the culture period and some wide necked bottles with anti-bacterial coating sample also turn into black, which shows a lot of SRB has reproduced and grown in the culture medium and in the bottle. This means this kind of anti-bacterial coating SRB resistance performance is bad. While some other wide necked bottles with anti-bacterial coating sample don’t turn into black obviously, which shows no SRB or very few SRB reproduces.

3. EVALUATION METHOD APPLICATION
Evaluate different coatings anti-bacterial performance by the above SRB resistance evaluation. Prepare different coating samples by the same resin and anti-bacterial material content, then evaluate their anti-bacterial performance and test their SRB content in the bottle by SRB testing bottle method, the results is shown in table 1.

<table>
<thead>
<tr>
<th>No.</th>
<th>coating No.</th>
<th>bacteria number before inoculation, unit/ml</th>
<th>inoculating bacteria number, unit/ml</th>
<th>bacteria number after culture, unit/ml</th>
<th>bactericidal ratio, %</th>
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<tr>
<td>1</td>
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<td>99.935</td>
</tr>
<tr>
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<td>B2</td>
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<td>950</td>
<td>95.25</td>
</tr>
<tr>
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<td>600</td>
<td>95</td>
<td>99.5</td>
</tr>
<tr>
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<td>B4</td>
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<td>600</td>
<td>2500</td>
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</tr>
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<td>B5</td>
<td>0</td>
<td>600</td>
<td>2000</td>
<td>90</td>
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<tr>
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<tr>
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<td>blank</td>
<td>0</td>
<td>600</td>
<td>20000</td>
<td></td>
</tr>
</tbody>
</table>

Table 1 different coating bactericidal ratio

It can be found B1 and B8 coatings have better anti-bacterial performance. And practical application results confirm B1 and B8 coatings good SRB resistance performance.

4. CONCLUSION

By evaluating different coating SRB resistance performance and practical application confirming, the evaluation introduced in this paper is simple, accurate and feasible. It can be used to evaluate coating SRB resistance in laboratory.

REFERENCE:
1. QB/T2591-2003 《antibacterial plastics-antibacterial performance test and effect》
2. Japanese industrial criteria JIS Z2801 《antibacterial product antibacterial effect and activity evaluation method》
3. Petroleum criteria SY/T0532 《oilfield water injecting bacteria analysis method》