

DISCUSSION

Turnbull¹ (discusser's question)—Is it possible to quantify the frequency of particle impact upon the surface?

T. Kohley and E. Heitz (authors' response)—Possible methods are (a) high-speed cinematography, (b) laser-doppler-anemometry and (c) acoustic methods. Experiments with methods (a) and (b) are under way. Results will be published in *Corrosion NACE*.

D. R. John² (discusser's question)—Did you find that the relative ranking of the materials tested was the same under all conditions applied?

T. Kohley and E. Heitz (authors' response)—The relative ranking of 13% chromium steel and ferritic-austenitic stainless steel (results are not part of the paper) are the same both in the erosion corrosion and abrasive wear region. In general, ferritic austenitic steels showed half of the mass loss rate as compared to 13% chromium steel.

T. S. Lee³ (discusser's question)—In comparing the polarization resistance and mass loss data, is it possible to identify what percent of the metal removal is attributable to electrochemical versus mechanical processes in both the abrasion and erosion-corrosion regions? What is the effect of the particle angularity on this distribution?

T. Kohley and E. Heitz (authors' response)—The distribution is approximately as follows:

abrasive wear region:

mechanical $90 \pm 5\%$

electrochemical $10 \pm 5\%$

erosion corrosion region:

electrochemical $70 \pm 10\%$

mechanical $30 \pm 5\%$

The scatter of data is due to restrictions in accuracy of the polarization resistance method. The effect of particle angularity on the distribution is not known. Further results on particle dynamics will be published in *Corrosion NACE*.

Y. F. Van Baar⁴ (discusser's questions)—(a) Can you specify the role of oxygen? and (b) Can you quantify the influence of CO₂ partial pressure?

T. Kohley and E. Heitz (authors' response)—(a) Oxygen content was below 20 ppb throughout the experiments. Increasing oxygen content leads to pitting on 13% chromium steel in particle-free formation water. It is not clear if the "residual" corrosion rate at zero sand content in Fig. 6 of the paper is due to traces of oxygen. In general, the influence of oxygen has not been investigated. (b) In particle-free formation water, nearly no difference between corrosion rates of carbon steel at 3 and 5 bar CO₂ at various flow rates have been found in the present investigation. However, this finding disagrees with practical experience. The influence of CO₂ partial pressure under conditions of erosion corrosion of 13% chromium steel is just now being investigated.

J. M. Sykes⁵ (discusser's question)—You have attributed the corrosion losses in pure water to the removal and reformation of the passive oxide film, yet the addition of inhibitor was able to reduce this loss very significantly. Do you have any ideas on how the inhibitor is able to do this?

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Can an inhibitor reduce the amount of charge required to form the passive oxide? Is it possible that passive oxide growth is accompanied by the formation of soluble species?

T. Kohley and E. Heitz (authors' response)—Your question refers to results already presented at the 6th European Symposium on Corrosion Inhibitors, Ferrara, Italy, Sept. 1985. Erosion corrosion as referred to in this paper can be effectively inhibited according to those results. Even if particle-containing distilled water with 3 bars nitrogen is used, a finite but small corrosion can be observed, which also can be inhibited. There is no definite answer to this problem. Possibly, the proposal that passive layer growth is accompanied by a parallel formation of soluble species is correct. This process should be susceptible to inhibition.