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INFORMAL REPORT

H_2 RELEASE RATE FROM CORROSION OF ZN

D. van Rooyen

July 1979

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Department of Nuclear Energy
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INTRODUCTION

BNL-NUREG-24532 on the release of H_2 from corrosion of Zn and Al was issued in May 1978. This reference put together the quantitative relationships between corrosion of the two metals at different temperatures and amounts of H_2 that would be released from such corrosion. It was pointed out that there was a considerable divergence of experimental results as reported in the literature especially in the case of Zn. Some additional areas for quantitative research were indicated and it is believed that NRC has incorporated these into their future plans.

BNL-NUREG-24532 expressed all of the data in terms of standard cubic feet (SCF) of H_2 per square foot per hour. Literature references often use different units for the same purpose and it has become a major task at times to convert corrosion rates or other units into SCF H_2 ft^{-2} $hr.^{-1}$. The main purpose of the present report is to provide a concise conversion chart for various of these units. Another contribution in the present report is the provision of a plot of specific and accurate determinations of H_2 release vs. temperature for corrosion of Zn, using graph paper with many intermediate lines to facilitate accurate conversion of corrosion data into volume of H_2 at various temperatures. The earlier curves did not contain sufficient detail to permit such accurate determinations.

DETAILS

The conversion factors for units of H_2, Al or Zn to be converted into other units are given in Table 1. In this table, the initial unit is in column 1, the multiplication factor in column 2, and the new unit in column 3. If it is necessary to convert from a unit in column 3 into a unit in column 1, then naturally one would divide by the factor given in the center column.

Fig. 1 is a plot of the inverse absolute temperature against log of SCF $ft.^{-2}$ $hr.^{-1}$ H_2 from the corrosion of Zn and is plotted as a straight line. This is the same as Fig. 11 of the earlier report and it corresponds to the equation of the Arrhenius type:

$$H_2 \text{ (SCF ft.}^{-2} \text{ hr.}^{-1}) = 4.678 \times 10^5 \exp\left(-\frac{14,500}{RT}\right)$$

Fig. 2 is a plot of the same data using degrees F against the log of H_2 volume. H_2 release rates can be obtained graphically or direct from the above equation.

CONCLUSIONS

It is suggested that until additional data are obtained for more accurate estimates of H_2 release rates from Zn corrosion, that the present curves can be used and that they would be sufficiently conservative for the purposes of the NRC, based on data available to us in the literature at this time.

TABLE I

CONVERSION FACTORS

Unit	Multiply by	Result is
SCF ft^{-2} $hr^{-1}(H_2)$	2.832×10^{4}	ml. ft^{-2} $hr^{-1}(H_2)$
	30.48	ml. cm^{-2} $hr^{-1}(H_2)$
	2.721	mg. cm^{-2} $hr^{-1}(H_2)$
	2.528×10^{3}	mg. ft^{-2} $hr^{-1}(H_2)$
lbs Al	19.95	SCF (H_2)
lbs Zn	5.489	SCF (H_2)
mils Al	3.018×10^{-4}	SCF cm^{-2} (H_2)
	0.2804	SCF ft^{-2} (H_2)
mils Zn	2.195×10^{-4}	SCF cm^{-2} (H_2)
	0.2039	SCF ft^{-2} (H_2)
mpy Al	3.201×10^{-5}	SCF ft^{-2} hr^{-1} (H_2)
mpy Zn	2.328×10^{-5}	SCF ft^{-2} $hr^{-1}(H_2)$
mdd Al	1.703×10^{-5}	SCF ft^{-2} $hr^{-1}(H_2)$
mdd Zn	4.684×10^{-6}	SCF ft^{-2} $hr^{-1}(H_2)$
moles dm^{-2} $hr^{-1}(H_2)$	7.349	SCF ft^{-2} $hr^{-1}(H_2)$
moles Zn	1	moles (H_2)
moles Al	1.5	moles (H_2)
lb. moles Zn	358.8	SCF (H_2)
lb. moles Al	538.2	SCF (H_2)
mole (H_2)	0.791	SCF (H_2)
lb. mole (H_2)	358.8	SCF (H_2)

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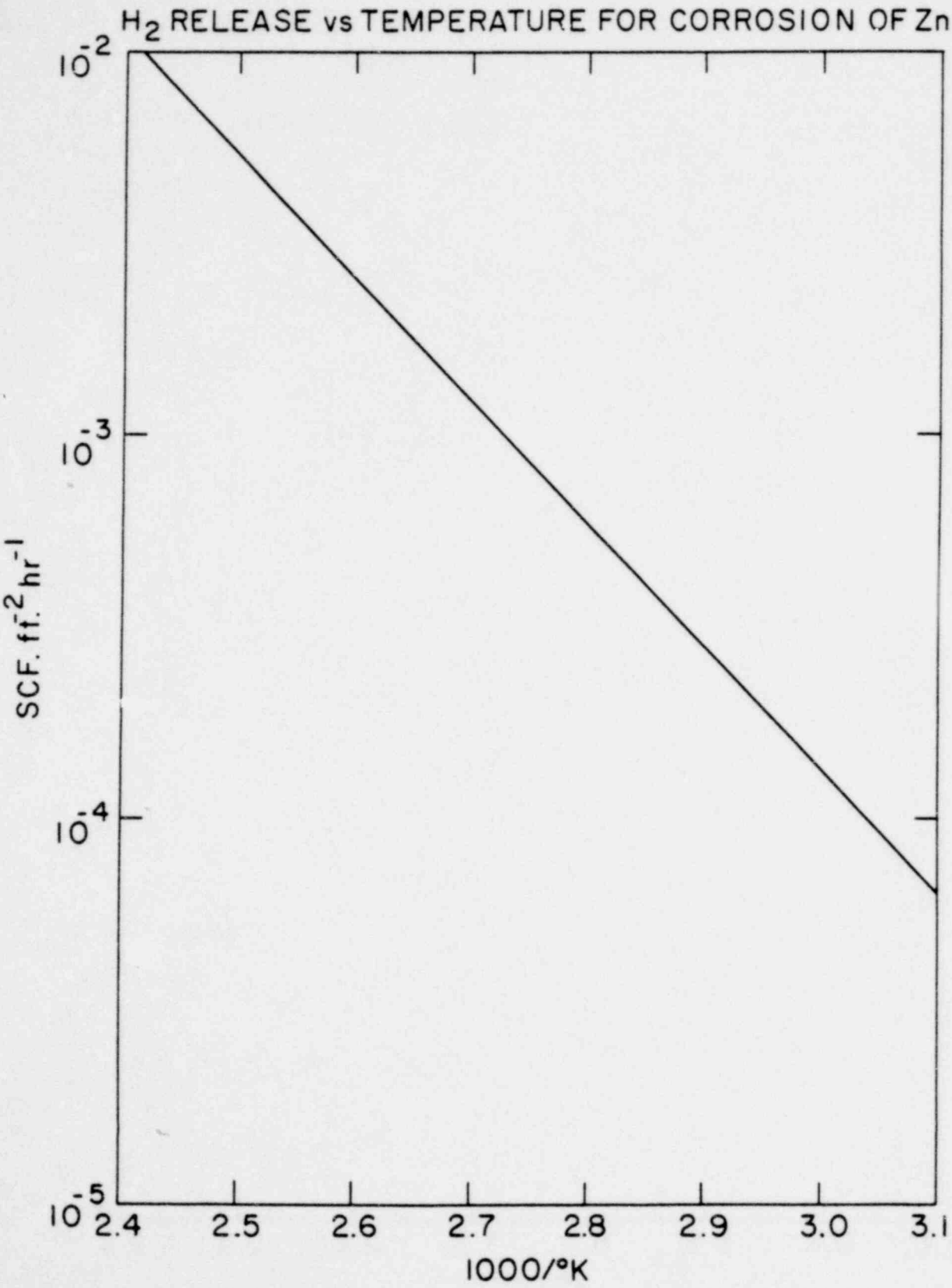

FIGURE 1

POOR ORIGINAL

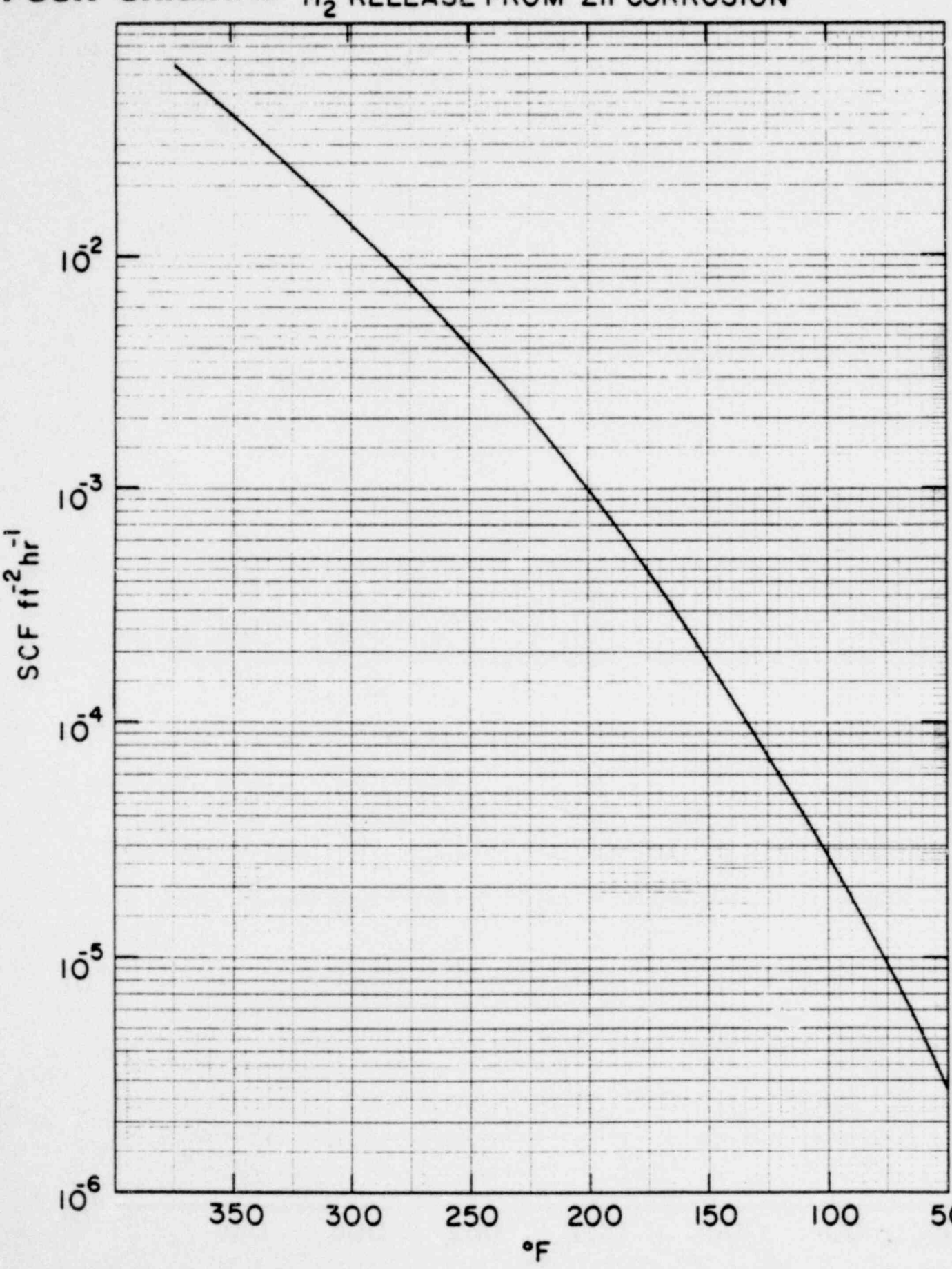

FIGURE 2

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