AC Analysis Case Study - Data Logging and Signal Analysis

Background

GPT Industries' Iso-Smart™ employs a patent-pending process using high sampling rates and advanced data processing engines to analyze customers' assets. It identifies "true" AC presence, crucial for detecting AC-induced corrosion on buried metallic pipelines, which leads to accelerated corrosion rates.

Referencing to *Figure 1,* below, "True" AC, in contrast to other forms of AC, changes direction relative to the signal's polarity. This means that the flow of electrons alternates back and forth, similar to a swinging pendulum. This constant change in direction is particularly harmful for localized pitting corrosion on metal surfaces buried in soil.

When "true" AC is present, cathodic protection, which aims to prevent corrosion by creating a protective film on the metal surface, becomes less effective. The continuous reversal of electron flow disrupts the formation and stability of this protective film, leaving the metal vulnerable to corrosion attack.

Additionally, the changes in pH caused by "true" AC can exacerbate corrosion. The alternating flow of electrons can lead to the accumulation of alkaline substances around the corrosion sites, raising the pH of the surrounding soil. This alkaline environment accelerates the destruction of passive films and promotes the formation and growth of corrosion pits on the metal surface.

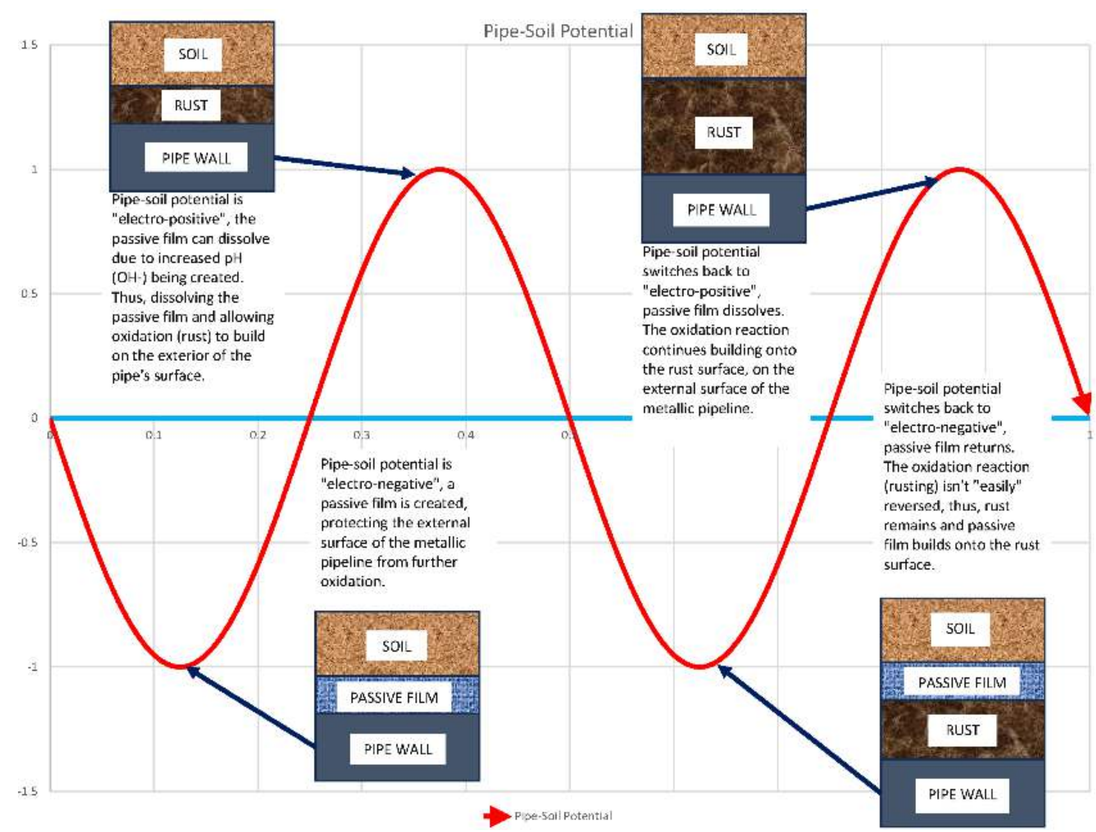

Figure 1: Example of a "true" AC sine wave.

In summary, the constant changes in electron flow direction, disruption of passive film formation from cathodic protection, and pH changes caused by "true" AC all contribute to the heightened detrimental effects on localized pitting corrosion.

This explanation will be critical in understanding the data analysis in the page(s) to follow, and why Iso-Smart™ is much different to any other RMU on the market today.

For further questions or explanation, please feel free to reach out to me directly.

Gabe Gonzales
Sr. R&D Engineer

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Analysis on an AC Coupon

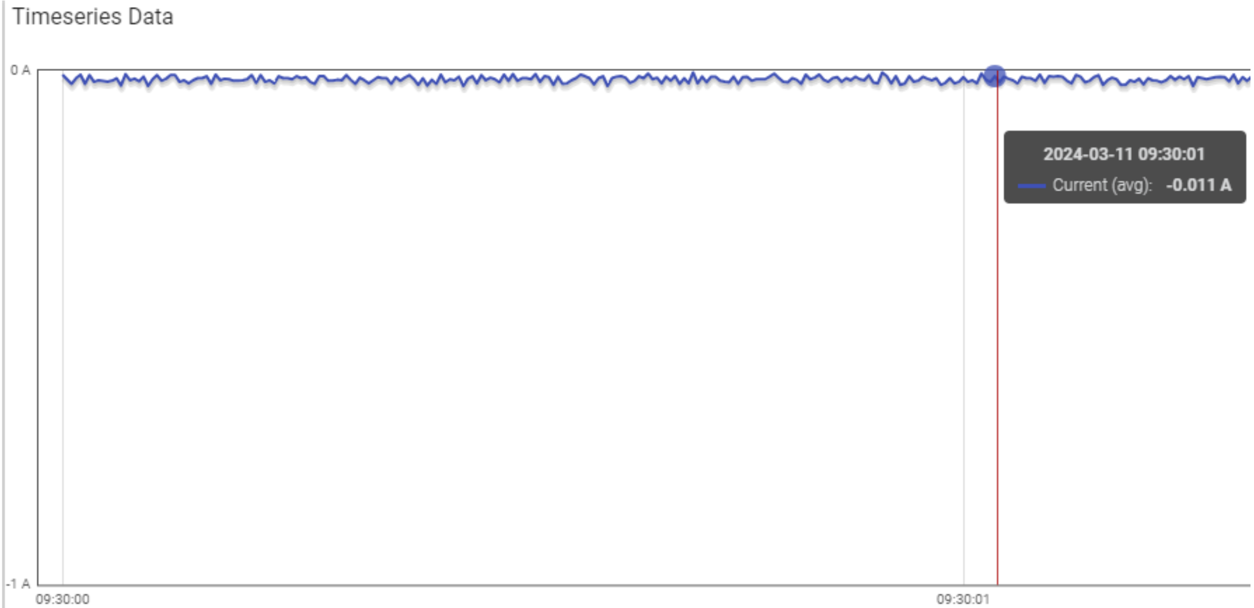

Figure 2: Current via AC Coupon

The current measured, shown in *Figure 2*, strongly presents that this current via the AC coupon is *not* of an AC source. Furthermore, through the signal analysis, as shown in Figure 3 and Figure *4*, there is hardly any fluctuation in the signal, with very little magnitude(s) of interest.

Current (A)

0.007 A(p-p) @ Hz
0.002 A(p-p) @ **77.15** Hz
0.001 A(p-p) @ **16.60** Hz
0.001 A(p-p) @ **9.77** Hz
0.001 A(p-p) @ **60.55** Hz
0.001 A(p-p) @ **45.90** Hz
0.001 A(p-p) @ **100.59** Hz
0.001 A(p-p) @ **58.59** Hz
0.001 A(p-p) @ **152.34** Hz
0.001 A(p-p) @ **83.98** Hz
0.001 A(p-p) @ **37.11** Hz
0.001 A(p-p) @ **125.98** Hz
Output of AC Magnitude(s) test.

Figure 3: AC Coupon-Current signal analysis.

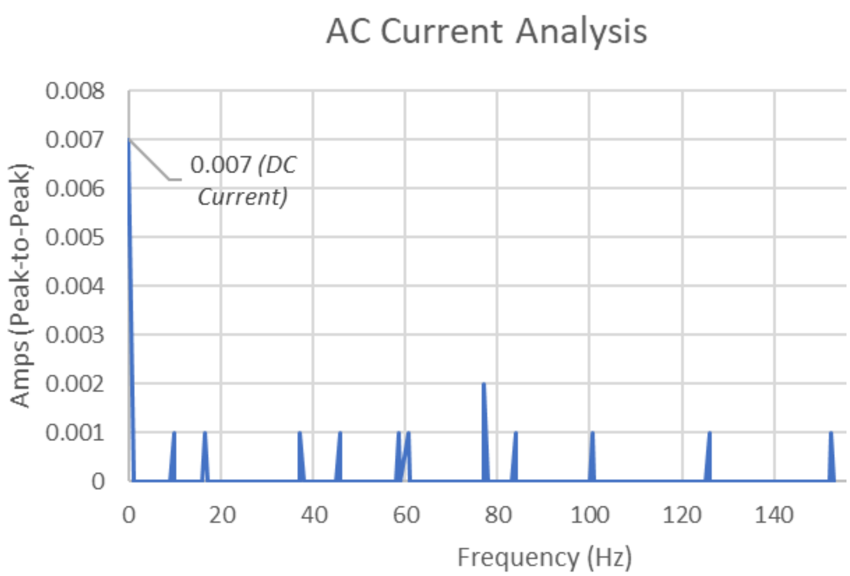

Figure 4: Graphed-AC Signal Analysis

This is the current which is being measured via a 1cm^2 AC coupon. With all this, we can confidently say, from this data, that the current at -0.007A and the coupon having an area of 1cm^2, gives us a current density of 70A/m^2 (**DC**). Keep in mind that this is of a DC source, most likely from the source of cathodic protection.

"IF" there is any AC on the line, it will have the frequency(s) shown in *4*. But also keep in mind that the current polarity is not changing, as seen in the data log and *Figure 2*, thus, greatly reducing the concern of pitting corrosion.

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Analysis on the Asset

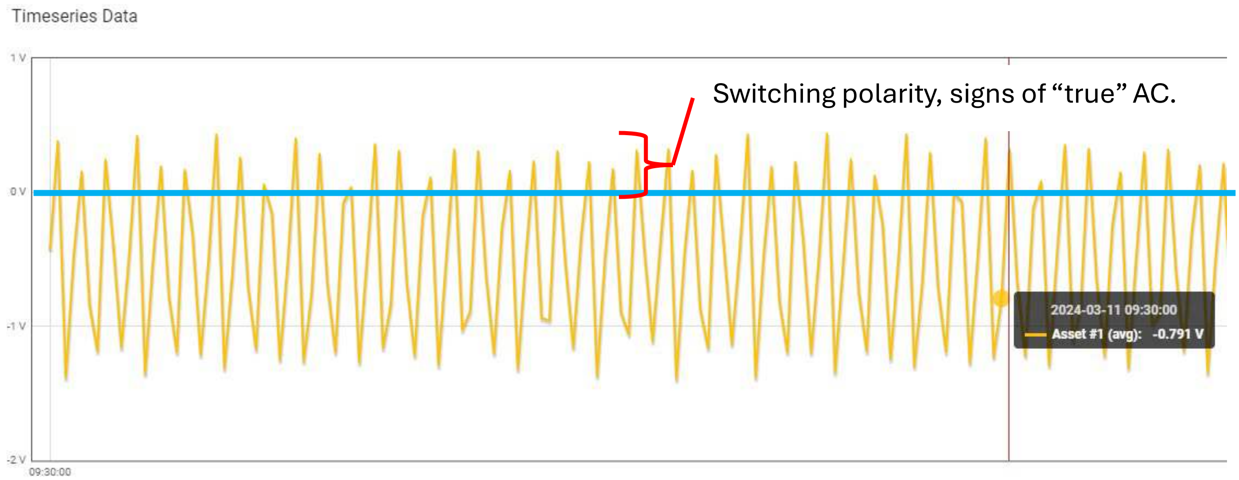

Figure 5: Asset #1 data log.

Looking at the potential of Asset #1, as shown in Figure 5, this is the asset’s potential with respect to a Zinc permanent reference electrode. Large fluctuations in the data log are seen. More importantly, the polarity is switching, as indicated by passing “0”, which is extremely detrimental in regard to pitting corrosion, as briefly explained on page 1. Furthermore, the signal analysis strongly suggests that there is AC present on Asset #1, as shown in *Figure 6* and Figure *7*.

Asset #1

0.53 V @ 0Hz
1.68 V(p-p) @ **59.57** Hz
0.69 V(p-p) @ **298.83** Hz
0.59 V(p-p) @ **60.55** Hz
0.46 V(p-p) @ **418.94** Hz
0.35 V(p-p) @ **239.26** Hz
0.34 V(p-p) @ **58.59** Hz
0.31 V(p-p) @ **120.12** Hz
0.28 V(p-p) @ **299.81** Hz
0.28 V(p-p) @ **119.14** Hz
0.25 V(p-p) @ **61.52** Hz
0.24 V(p-p) @ **179.69** Hz
0.19 V(p-p) @ **341.80** Hz
Output of AC Magnitude(s) test.

Figure 6: Asset #1 AC Signal Analysis

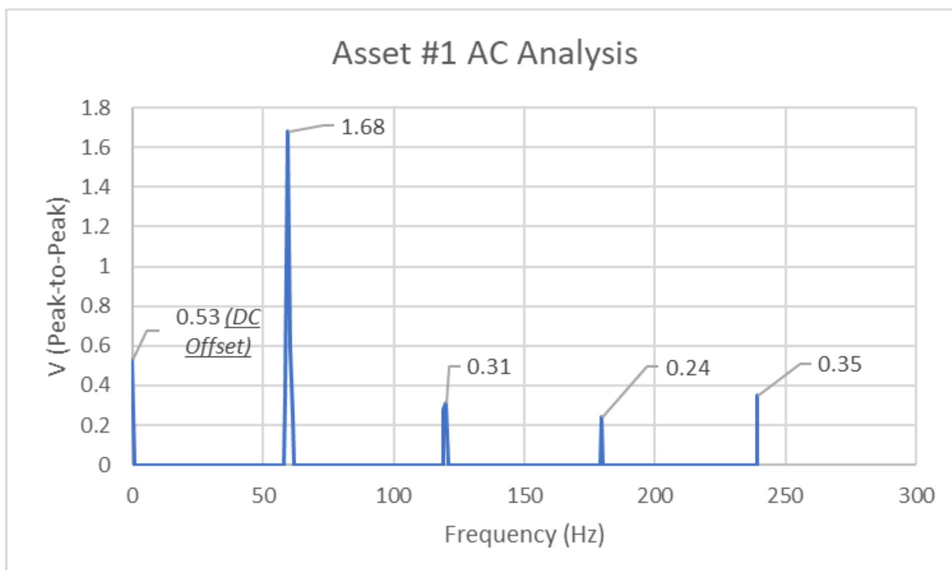

Figure 7: Graphed - Asset #1 AC Signal Analysis

All in all, there <u>is</u> AC present on Asset #1 at coupon test station. Although, the data also suggests that the AC <u>isn’t</u> coming onto the asset via the AC Coupon, rather, it’s already present on the line. A possible source could be from induced AC from HVAC lines near these asset(s) or from another direct connection/location.

On the Iso-Smart™ dashboard, you will be able to access both current and voltage readings at the same time, as shown in the sample data logs.

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Sample Data Logs