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August 2017

Potash Corporation  
Swift Creek Chemicals Plant  
Post Office Box 300  
White Springs, Florida 32096-0300  
ATTN: Mr. Ken Tut  
Project Representative

Swift Creek Chemicals Plant  
Effectiveness of Cathodic Protection  
Survey Underground Natural Gas System

## **INTRODUCTION**

The annual cathodic protection survey was conducted for Potash Corporation – Swift Creek Chemicals Plant during the month of August 2017. During this survey, the Swift Creek Chemicals Plant natural gas system was inspected for the effectiveness of cathodic protection, as applied. The cathodic protection system for the Swift Creek Chemicals Plant consists essentially of Galvomag Magnesium anodes placed in various locations throughout the natural gas system.

## **RESULTS AND ANALYSIS**

A total of Three [3] structure readings and One [1] anode reading was taken during this survey. As can be seen by the structure-to-soil potential measurements and the enclosed data sheet, 100% of the gas pipeline readings obtained are indicative of cathodic protection. A structure-to-soil potential of 850 millivolts or more negative direct current is the basis used in this report to confirm cathodic protection.

### **IR DROP CONSIDERATION**

The effectiveness of any cathodic protection system can be determined by taking potential measurements between the structure and a reference electrode. These potential measurements have traditionally been recorded with “average reading” digital voltmeters while the protective current is flowing or applied. These on-potential measurements contain the error produced by the voltage drop in the soil (electrolyte) and the voltage drop in the structure being protected. This error is referred to as *IR* drop. Interpretation of a current applied measurement requires consideration of the significance of voltage drops in the earth and metallic paths.

An instant off-potential measurement is the reading taken instantaneously after the protective current reaches zero. Off-potential measurements eliminate the *IR* drop error, allowing the true *IR* drop free polarized potential of a cathodically protected structure to be determined in the field. *IR* drop error is eliminated since there is no current flowing when the measurement is taken (i.e.,  $I=0$ ).

### **SURVEY TEST INSTRUMENTATION**

The Cathodic Protection Analyzer, developed by Universal Rectifiers, Inc, (Hereinafter referred to as CPA), is a handheld instrument used with a reference electrode to measure the uninterrupted characteristics of the signal generated from a CP source. It can be used to evaluate the coating of a pipeline to ensure that the pipe is fully protected from corrosion. The CPA is designed for use with any pipeline system or structure at risk to corrosion factors. Aging pipes and changing conditions can cause significant problems, such as an increase in applied CP levels and enlarged holidays in coating. In addition, increased environmental concerns also emphasize the need to minimize leaks as much as possible.

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The CPA has computer capabilities of filtering interfering signals. The instrument is also capable of measuring several facets of the protection waveform. The software-driven instrument reads the minimum, average, and maximum voltage levels emanating from the pipe, thereby allowing an overview of the entire CPv signature. Digital signal processing makes the accuracy and precision of the CPA possible. It utilizes software to provide the extra speed and flexibility that is becoming increasingly important in the field.

The CPA is operated in conjunction with a Copper – Copper Sulfate [Cu/CuSO<sub>4</sub>] shielded reference electrode known by its model number SPI, which allows the measurement of the cathodic protection voltage without interrupting the potential source.

## **RECOMMENDATIONS**

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The sacrificial galvanic anode arrangement designed to protect the coated and wrapped steel natural gas system indicates adequate current to afford cathodic protection to the steel distribution system. Structure-to-soil readings obtained from One [1] Cathodic Test Point and One [1] 8" gas riser on the steel distribution system indicate CP readings above State and Federal minimum standards of -0.850 volts direct current.

At this time, the Natural Gas Distribution System for Potash Corporation's Swift Creek Chemicals Plant complex indicates cathodic protection levels exceeding State and Federal minimum guidelines for applied cathodic protection I trust the above information to be satisfactory and in sufficient detail, however, should you require additional information, please contact me.

Sincerely,



Mitchell Whitfield  
C.P. Tester

## **CATHODIC TEST POINTS**

## **CATHODIC TEST POINTS**

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Underground Natural Gas System  
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### Cathodic Test Point - #1

Green Anode Wire	-1.625 Vdc
Green/Black Gas Pipeline Wire	-1.257 Vdc
Green Gas Pipeline Wire	-0.564 Vdc
Structure-to-Soil 8" Riser	-1.825 Vdc