

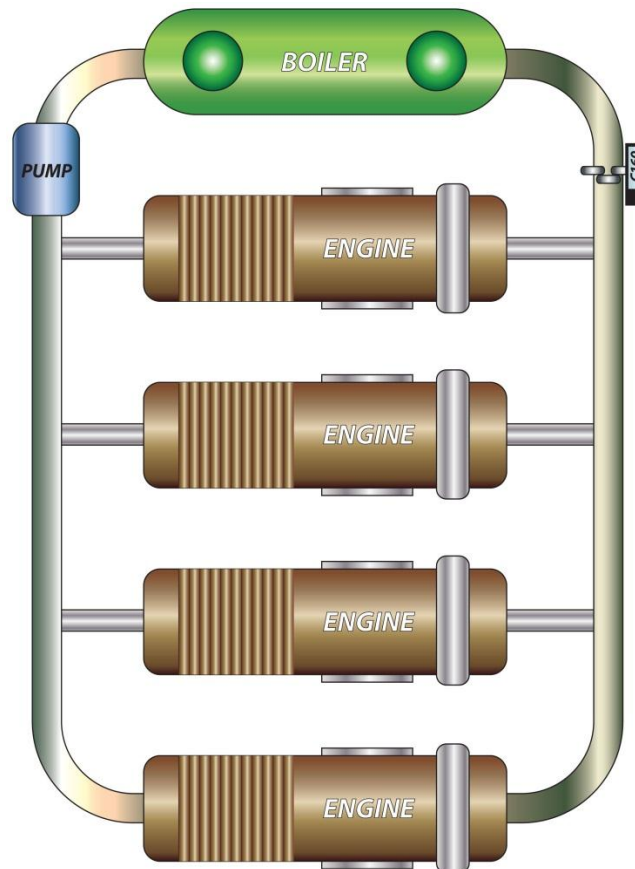
February 2011

## Preliminary Report - Williams Northwest Pipeline

**Location:** Williams Northwest Pipeline Gas Booster Station in Plymouth, WA, USA.

**Schedule trial Period:** 6 months (mid-September 2010 to mid-March 2011).

**Installation goal:** Reduce limescale buildup and mechanical wear in the Engine Jacket Hot Water System (closed loop system with no make-up water added).



The booster station uses gas-powered engines to boost gas through the regional pipeline (Northwestern USA). On cold winter days, the engines need to be heated in order to start. This task is achieved by running preheated water (160 degrees Fahrenheit), in a closed hot water system, through the engine jackets.



Gas powered engine



The engine jackets need to be serviced periodically due to limescale accumulation which effects heat transfer efficiency.



In mid-September 2010, a *HydroFLOW* C160 water conditioner was installed on the water inlet pipe to the system's boiler.



Oscilloscope reading of the unique electric signal being propagated into the water system by the *HydroFLOW* C160 water conditioner.

## Results to date (4 months into the trial)

**May 2009 water analysis (prior to C160 installation):** Water hardness at 16 ppm and corrosion rate at 0.33.

The DOW CHEMICAL COMPANY

**NORKOOL™**

Heat Transfer Fluids

**NORKOOL™**

### Sample Analysis Report

Rob Fleming  
Transcontinental Gas (Williams Gas Pipeline West)

Sample Number: 2009-056-0058  
Report Date: 05/05/2009

Sample Label Description: Station 14 C/S

		<u>New Data</u>	<u>Acceptable</u>
<b>Appearance:</b>		yellow	---
Color		clear	clear
Clarity		<0.01	<0.01
Sediment	wt%		
<b>Concentration &amp; Freeze Point:</b>			
Ethylene Glycol	vol% EG	29	30-60
Propylene Glycol	vol% PG	15	30-60
Freeze Point	deg F	-21	---
Freeze Point	deg C	-30	---
<b>Chemical Properties</b>			
Fluid pH		8.4	8-10.5
Reserve Alkalinity	ml of 0.1N HCl	5.7	>8
<b>Corrosion Inhibitors:</b>			
Nitrite	ppm NO2	0	>600
Phosphate	ppm PO4	3381	>2500
Tolytriazole	ppm C7H7N3	1036	>100
<b>Corrosives &amp; Scale Promoters:</b>			
Chloride	ppm Cl	16	<200
Sulfate	ppm SO4	101	<500
Total Hardness	ppm CaCO3	16	<300
Ferrous metal corrosion rate	mils per year (mpy)	0.33	<0.5
Copper corrosion rate	mils per year (mpy)	0.06	<0.5
<b>Glycol Degradation &amp; Contaminants:</b>			
Total Degradation Acids	ppm as C2H4O3	4084	<3000
Nitrate	ppm NO3	19	<500
MBT	ppm MBT	0	<500
Diethylene Glycol	vol% DEG	0	<1
Triethylene Glycol	vol% TEG	0	<1

#### FLUID MAINTENANCE RECOMMENDATIONS:

This fluid is suitable for continued use. Note the following warning(s): Nitrite is below specification for NORKOOL but this condition is acceptable as long as chlorides remain under 100 ppm and sulfates remain under 250 ppm. A mixture of ethylene and propylene glycols was detected. The presence of ethylene glycol negates the benefit of using a low toxicity propylene glycol fluid.

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For technical assistance regarding this report please contact Jill Rose-Fousse at 989-636-5530  
For sales and general information about our products please contact Dow Customer Service: 1-800-447-4369

**November 2010 water analysis (1 month after C160 installation): Water hardness down to 12 ppm and corrosion rate up to 0.45.**

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**DOW HTF**

Heat Transfer Fluids

**DOW HTF**

*Sample Analysis Report*

Dean Glatt  
Transcontinental Gas (Williams Gas Pipeline West)

Sample Number: 2010-046-0087  
Report Date: 05/11/2010

**Sample Label Description: Compressor Station**

		<u>New Data</u>	<u>Acceptable</u>
<b>Appearance:</b>			
Color		amber	---
Clarity		clear	clear
Sediment	wt%	<0.01	<0.01
<b>Concentration &amp; Freeze Point:</b>			
Ethylene Glycol	vol% EG	37	30-60
Propylene Glycol	vol% PG	20	30-60
Freeze Point	deg F	-54	---
Freeze Point	deg C	-48	---
<b>Chemical Properties</b>			
Fluid pH		8.2	8-10.5
Reserve Alkalinity	ml of 0.1N HCl	9.6	>8
<b>Corrosion Inhibitors:</b>			
Phosphate	ppm PO4	3327	>2500
Tolytriazole	ppm C7H7N3	1025	>100
<b>Corrosives &amp; Scale Promoters:</b>			
Chloride	ppm Cl	26	<100
Sulfate	ppm SO4	102	<250
Total Hardness	ppm CaCO3	12	<200
Ferrous metal corrosion rate	mils per year (mpy)	0.45	<0.5
Copper corrosion rate	mils per year (mpy)	0.06	<0.5
<b>Contaminants &amp; Other Glycols:</b>			
Total Degradation Acids	ppm as C2H4O3	2964	<3000
Nitrite	ppm NO2	0	<100
Nitrate	ppm NO3	0	<100
MBT	ppm MBT	0	<100
Diethylene Glycol	vol% DEG	0	<1
Triethylene Glycol	vol% TEG	0	<1

**FLUID MAINTENANCE RECOMMENDATIONS:**

This fluid is suitable for continued use. Note the following warning(s): A mixture of ethylene and propylene glycols was detected. The presence of ethylene glycol negates the benefit of using a low toxicity propylene glycol fluid.

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**December 2010 water analysis (2 months after C160 installation): Water hardness down to 10 ppm and corrosion rate down to 0.18.**

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**DOW HTF**

Heat Transfer Fluids

**DOW HTF**

*Sample Analysis Report*

Dean Glatt  
Transcontinental Gas (Williams Gas Pipeline West)

Sample Number: 2010-121-0141  
Report Date: 12/03/2010

**Sample Label Description: Compressor Station**

		<u>New Data</u>	<u>Acceptable</u>
<b>Appearance:</b>			
Color		amber	---
Clarity		clear	clear
Sediment	wt%	<0.01	<0.01
<b>Concentration &amp; Freeze Point:</b>			
Ethylene Glycol	vol% EG	28	30-60
Propylene Glycol	vol% PG	17	30-60
Freeze Point	deg F	-22	---
Freeze Point	deg C	-30	---
<b>Chemical Properties</b>			
Fluid pH		8.2	8-10.5
Reserve Alkalinity	ml of 0.1N HCl	11.7	>8
<b>Corrosion Inhibitors:</b>			
Phosphate	ppm PO4	3818	>2500
Tolytriazole	ppm C7H7N3	1082	>100
<b>Corrosives &amp; Scale Promoters:</b>			
Chloride	ppm Cl	0	<100
Sulfate	ppm SO4	89	<250
<b>Total Hardness</b>	<b>ppm CaCO3</b>	<b>10</b>	<200
Ferrous metal corrosion rate	mils per year (mpy)	0.18	<0.5
Copper corrosion rate	mils per year (mpy)	0.05	<0.5
<b>Contaminants &amp; Other Glycols:</b>			
Total Degradation Acids	ppm as C2H4O3	4729	<3000
Nitrite	ppm NO2	0	<100
Nitrate	ppm NO3	19	<100
MBT	ppm MBT	0	<100
Diethylene Glycol	vol% DEG	0	<1
Triethylene Glycol	vol% TEG	0	<1

**FLUID MAINTENANCE RECOMMENDATIONS:**

This fluid is suitable for continued use. Note the following warning(s): A mixture of ethylene and propylene glycols was detected. The presence of ethylene glycol negates the benefit of using a low toxicity propylene glycol fluid.

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## February 2010 water analysis (4 months after C160 installation): Water hardness down to 0 ppm and corrosion rate stable at 0.22.

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### Sample Analysis Report

Dean Glatt  
Transcontinental Gas (Williams Gas Pipeline West)

Sample Number: 2011-012-0052  
Report Date: 02/10/2011

Sample Label Description:	Untitled Sample	<u>New Data</u>	<u>Acceptable</u>
<b>Appearance:</b>			
Color		green	---
Clarity		clear	clear
Sediment	wt%	<0.01	<0.01
<b>Concentration &amp; Freeze Point:</b>			
Ethylene Glycol	vol% EG	28	30-60
Propylene Glycol	vol% PG	17	30-60
Freeze Point	deg F	-24	---
Freeze Point	deg C	-32	---
<b>Chemical Properties</b>			
Fluid pH		8.2	8-10.5
Reserve Alkalinity	ml of 0.1N HCl	5.2	>8
<b>Corrosion Inhibitors:</b>			
Phosphate	ppm PO4	3763	>2500
Tolytriazole	ppm C7H7N3	1067	>100
<b>Corrosives &amp; Scale Promoters:</b>			
Chloride	ppm Cl	0	<200
Sulfate	ppm SO4	105	<500
<b>Total Hardness</b>	<b>ppm CaCO3</b>	<b>0</b>	<b>&lt;300</b>
Ferrous metal corrosion rate	mils per year (mpy)	<b>0.22</b>	<0.5
Copper corrosion rate	mils per year (mpy)	<b>0.06</b>	<0.5
<b>Glycol Degradation &amp; Contaminants:</b>			
Total Degradation Acids	ppm as C2H4O3	3146	<3000
Nitrite	ppm NO2	0	<500
Nitrate	ppm NO3	285	<500
MBT	ppm MBT	0	<500
Diethylene Glycol	vol% DEG	1	<1
Triethylene Glycol	vol% TEG	0	<1

**FLUID MAINTENANCE RECOMMENDATIONS:**

The condition of this fluid is unusual for a Dow fluid and deviates from properly installed / maintained Dow heat transfer fluid. A mixture of ethylene and propylene glycols was detected. The presence of ethylene glycol negates the benefit of using a low toxicity propylene glycol fluid.

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## Preliminary conclusions

1. This application was labeled as very difficult to begin with, since the water was already relatively soft, no make-up water is added, no filter is used and no blow-down is performed.

Note: The *HydroFLOW* water conditioner requires hard water in order to dissolve existing limescale deposits.

2. Water hardness was reduced to 0 ppm due to the crystallization of the calcium carbonate ions. In this case, the microscopic crystals most likely accumulated as sediment powder on the bottom of the system's water tanks. These sediments can be easily removed during scheduled maintenance.

Note: In closed water systems, microscopic aragonite (limescale) crystals can either be filter out or removed by blow-down.

3. To date, the engine jackets were yet to be removed and examined. We assume there will be minor limescale deposits which can be easily removed during maintenance. Since the water hardness is 0 ppm, additional limescale will not accumulate inside the engine jackets.
4. The corrosion rates stayed stable at (0.18 to 0.22) and will continue to stay stable as long as the C160 is running.

Note: Corrosion rate reduction was not the purpose of the installation.

**Williams Northwest Pipeline has agreed to put together a detailed report in the coming months. See email below from Joe Frazzini, the Maintenance Manager of the Plymouth Booster Station.**

Regards,

Tal Journo  
Office: 1-509-987-1065  
Fax: 1-509-987-1067  
Email: tal@hydroflow-usa.com

From: Frazzini, Joe [mailto:joe.frazzini@williams.com]  
Sent: Thursday, February 10, 2011 12:56 PM  
To: Tal Journo; Doug Bryant  
Subject: Plymouth cooling water sample

Gentlemen,

Attached is the latest sample result, the sample was taken in mid-January 2011. I have included the previous sample reports in reverse chronological order for reference.

I was shocked to see total hardness at 0 so I verified with litmus paper test strips and it is 0. I see this as great news, bad news. The great news is that it shows that the Hydropath technology works as expected and did exactly what Dr. Stefanini said it would (reduce total hardness to 0). The bad news is that we do not have any calcium carbonate in the system to create the reaction needed to continue dissolving existing scale.

We still need to inspect the jacket water liners for evidence of scale and or scale removal but outside of that I would conclude that this test has been a success. I will check with our maintenance technicians to see when the inspection is possible. I would like to visit with you to plan a course of action for continued evaluation.

Thank you,

Joe Frazzini  
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509-735-4717 Fax  
509-947-1334 cell