

NATIONAL TRANSPORTATION SAFETY BOARD

Washington, D.C.

Attachment V REFERENCE 25

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Line 6B Chemical Inhibition for Corrosion Control

BACKGROUND:

In the absence of water, crude oil is non-corrosive¹. Industry investigations have shown steel corrosion rates to fall in the range of 0.01-0.001 mpy for typical Enbridge crudes². This is due to the historical use of sediment and water tariff limits (<0.5% S&W typical) that render the bulk fluid non-corrosive.

While Enbridge has benefited from a long history without significant internal corrosion, corrosive conditions can develop at locations where these trace crude contaminants may accumulate and persist over long periods of time. Pipelines with insufficient flow velocity to entrain these materials present a higher risk to internal corrosion than fast flowing pipelines. In light of these concerns, Enbridge identified Line 6B as being at risk of internal corrosion in 1994/1995, and began a chemical inhibition program to prevent internal corrosion in 1996.

CHEMISTRY SELECTION:

The chemical for Line 6B was selected based on the low water cut of this pipeline: the chemical needed to have a high affinity to water and be designed to partition strongly to the water phase even when the water phase is a very minor component of the total flow.

Based on third party testing conducted in 1993 and 1994, a two component product manufactured by Betz Dearborn was selected. The product presents superior film forming corrosion protection in brine, and is effective at reducing bacterial activity. The proportion of the two components was slightly altered in 1999 to achieve higher bacteria control without sacrificing film forming ability. The product is now provided by GE Water and Infrastructure (who purchased Betz Dearborn), under the name PL-1554 and PL1554W (with reduced freezing point for wintertime use). MSDS for these products are provided.

DOSAGE AND APPLICATION

Enbridge third party consultants established the dosage calculation that is currently used by Enbridge. This calculation considers the length and diameter of the pipe segment to determine the total internal surface area to be protected. The volume of chemical to be injected is determined by multiplying this internal surface area of the pipe by 0.001". The total volume of chemical is injected over a specified time period – typically four (4) hours – which was arrived at through bacteria control tests.

In order to remove accumulated materials (sediment and water) and prepare the pipe surface for treatment, the chemical is preceded by a cleaning pig equipped with wire brushes. The chemical is followed by a 'batch' or 'sealing' pig to improve the longitudinal and circumferential contact of the chemical inhibitor.

From construction to mid 2010, Line 6B was cleaned and batched as 293 mile long segment from Griffith to Sarnia, with chemical injections between the pigs at Griffith, Mendon, and Howell pump stations. The volumes injected at each station are presented below:

Station Start	Station End	Length (mi)	Volume (USG)	Injection Rate (gpm @ 4 hrs)
Griffith	Mendon	111.2	2874	12.0
Mendon	Howell	101.4	2620	10.9
Howell	Sarnia	80.0	2067	8.6

Using an average Line 6B flow rate of 240 kbpd and a 0.5% water cut, the resulting concentration of inhibitor in the water phase would be 250,000ppm, which exceeds the minimum allowable concentration of 500ppm.

¹ "Standard Guide for Determining Corrosivity of Crude Oils", ASTM, Approved Draft of new standard, August 2010.

² Friesen, et al, "Relative Corrosivities of IPC Fluids, Final Report", Report #WRC 95-32, CanMet Western Research Center.