

February 26, 2014

IS IT ETHYLENE OR PROPYLENE GLYCOL?

Recently a water treatment associate asked me: "Is there any existing test method for deciphering which type of glycol is present in a sample?" That was a new one to me, but being an Analytical Chemist, I was up to the challenge. I was even more intrigued when he told me that he had discussed this with many others and no one could answer this question. I love a challenge. So, I studied the physical properties of the two glycols and discovered that it is remarkably easy to differentiate between them.



This is all you need.

SPECIFIC GRAVITY. The key to differentiation is to use the physical differences with regard to Specific Gravity and Refractive Index. I would recommend the use of a hydrometer with a scale from 1.0 to 1.07, along with a glass 300 ml graduate cylinder to determine the Specific gravity of the solution. Perform this test first. Fill the cylinder with 250 ml - 300 ml of the unknown sample. Then insert the hydrometer into the cylinder. At the water line, read and record the numerical value of the nearest graduation mark. If the value is 1.05 or above, then (allowing for a 0.05 error) your solution is Ethylene Glycol based. It is impossible for Propylene Glycol solutions to have a Specific Gravity at or above 1.045 at 70 degrees Fahrenheit. See the tables below.

ETHYLENE GLYCOL		
WEIGHT %	VOLUME %	SG @70 deg F
0.0%	0.0%	1.0000
5.0%	4.5%	1.0057
10.0%	9.1%	1.0113
15.0%	13.7%	1.0170
20.0%	18.3%	1.0226
25.0%	23.0%	1.0283
30.0%	27.8%	1.0339
35.0%	32.6%	1.0396
40.0%	37.5%	1.0452
45.0%	42.3%	1.0509
50.0%	47.3%	1.0565
55.0%	52.3%	1.0622
60.0%	57.4%	1.0678
65.0%	62.5%	1.0735
70.0%	67.7%	1.0791
75.0%	72.9%	1.0848
80.0%	78.2%	1.0904
85.0%	83.6%	1.0961
90.0%	89.0%	1.1017
95.0%	94.5%	1.1074
100.0%	100.0%	1.1130

PROPYLENE GLYCOL		
WEIGHT %	VOLUME %	SG @70 deg F
0.0%	0.0%	1.0000
5.0%	4.8%	1.0059
10.0%	9.7%	1.0079
15.0%	14.5%	1.0150
20.0%	19.4%	1.0171
25.0%	24.3%	1.0200
30.0%	29.2%	1.0239
35.0%	34.2%	1.0285
40.0%	39.1%	1.0330
45.0%	44.1%	1.0355
50.0%	49.1%	1.0366
55.0%	54.1%	1.0373
60.0%	59.1%	1.0387
65.0%	64.2%	1.0415
70.0%	69.2%	1.0432
75.0%	74.3%	1.0435
80.0%	79.4%	1.0438
85.0%	84.5%	1.0429
90.0%	89.7%	1.0414
95.0%	94.8%	1.0394
100.0%	100.0%	1.0373

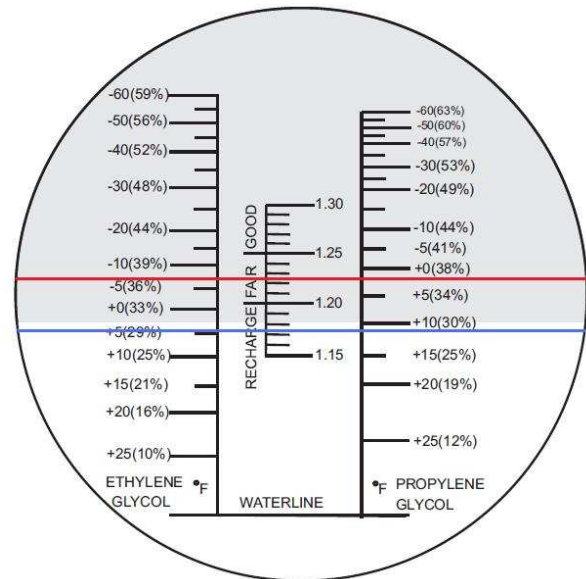
REFRACTIVE INDEX. If the Specific Gravity is between 1.0 and 1.05 (0.05 margin of error added), then you must do the Refractive Index to determine which glycol is present. I recommend using a hand held refractometer such as the one shown in the photo above. They are relatively inexpensive and easy to use in the field.

To perform this test all you have to do is place a few drops of your unknown sample liquid on the measurement prism at the end of the refractometer. Close the cover so the liquid spreads evenly across the entire surface of the prism without any air bubbles or dry spots. Allow this to remain on the prism for approximately 30 seconds. Instructions will vary slightly. It is best to use the instructions that come with your chosen refractometer.

Let us use a hypothetical Specific Gravity of 1.03 from the test above. A Specific Gravity of 1.03 means that you either have an Ethylene Glycol solution between 25% and 30% by weight, or you have a Propylene Glycol solution between 35% and 40% by weight. Which is it?

In the refractometer field of view at the right you can see an area of grey scale and an area of white. The junction of these two determines the percent strength of a known Glycol. Here it shows that the solution could be 30% Propylene Glycol. Or perhaps it could be approximately 30% Ethylene Glycol.

But we now are going to use this device to identify an unknown glycol which we know to have two totally different percentages of strength. In our hypothetical example, if the grey and white shaded areas meet near the red line (red line added for the purpose of demonstration) our unknown is a Propylene Glycol solution. If, however, the grey and white shaded areas meet near the blue line (blue line added for the purpose of demonstration) our unknown is an Ethylene Glycol solution.



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As a footnote, refractometers, hydrometers, and the glass 300 ml graduated cylinder show above can be purchased on www.TheWaterTreatmentStore.com.