

2007 Crude Characteristics  
No. 38

## 2007 CRUDE CHARACTERISTICS

The 2007 Crude Characteristics Booklet is a summary of selected chemical and physical properties of crude oils and condensates moved in the Enbridge Pipelines Inc. (Enbridge)/Enbridge Energy Partners, L.P. system. Samples were collected over a limited period of time and may or may not be representative of shipments over the entire year.

Density at 15C, Reid Vapour Pressure at 37.8C, Sulphur by Weight, Pour Point and Viscosity results at 10, 20, 30, 40 and 45C were tabulated. Example viscosity-temperature curves have been provided and the user is invited to plot any viscosities of interest on the blank graphs included.

### The data was accumulated as follows:

- 1- Incoming streams were sampled as received and later tested at central laboratories in Edmonton and Superior.
- 2- Commodities blended at Enbridge from a variety of incoming streams were sampled and tested at Superior.
- 3- Data was obtained from samples collected during the first three months of 2007. When available, routine testing throughout the year is used in place of samples collected for this program. The routine test results include:
  - a) Density figures for all incoming streams (not Enbridge blended ones) are calculated as the volume weighted average of all June 2006 to June 2007 receipts.
  - b) Density figures for all blended streams are calculated as the volume weighted average of all June 2006 to June 2007 deliveries.
  - c) All density figures are current as per above including samples indicated as using the previous year's results.
  - d) Sulphur values for all Mixed Blend contributors are taken from averages of the 'Crude Equalization Sulphur Summaries' (June 2006 to June 2007).
  - e) Sulphur values for all SW, SO, SHE, SLE, LSB, and M are taken from averages of routine tests at Superior terminal (June 2006 to June 2007).
  - f) All Western Canada condensate RVP and sulphur values are averages calculated from June 2006 to June 2007 monthly condensate testing.
  - g) Norman Wells crude RVP taken from daily RVP test results from June 2006 to June 2007.
  - h) All pour point results are from 2007 testing (pour point tests only conducted every second year).

## VISCOSITY-TEMPERATURE RELATIONSHIP

The viscosity test of a commodity characterizes its resistance to flow in pipeline movement. The test itself may exaggerate the low temperature viscosity of paraffinic crude oils. Previous testing has shown that the viscosity behaviour of a crude oil in a pipeline follows a curve somewhere between the apparent viscosity (the extrapolated straight line portion of the viscosity-temperature plot) and the measured viscosity.

Measured values of viscosity should be used for interlab comparisons. Apparent values should be used for head loss calculations and surcharge grouping.

To increase pumping capacity, Enbridge/LPL has limited receipt viscosities to 350 cs. As seasonal temperatures vary, the blends of heavier crude oils with diluent will change to meet the viscosity limit.

## 2007 Crude Characteristics

| Product Identifier | Crude Type (Long Name)       | Total Sulphur (% by wt.) | Pour Point (C) | Reid Vapour Pressure (kPa) | Density (kg/m3) | Viscosity (cSt) at Specified Temperature (degree Celsius) |         |         |        |        |
|--------------------|------------------------------|--------------------------|----------------|----------------------------|-----------------|---|---------|---------|--------|--------|
|                    |                              |                          |                |                            |                 | 10.00   | 20.00   | 30.00   | 40.00  | 45.00  |
| ACB                | AMOCO CONDENSATE - SARNIA    | 0.06**                   | <-30**         | 92.3**                     | 690.2*          | 0.580**   | 0.535** | 0.480** | Boiled | n/a    |
| AHS                | ALBIAN HEAVY SYNTHETIC       | 2.70                     | <-30           | 50.0                       | 935.0           | 248   | 127     | 71.5    | 44.3   | 35.5   |
| ARB                | ALBIAN RESIDUAL BLEND        | 2.58                     | <-30           | 11.0                       | 932.2           | 257   | 134     | 77.0    | 47.6   | 38.3   |
| BG                 | BONNIE GLEN                  | 0.41                     | <-30           | 74.0                       | 816.3           | 4.14  | 3.29    | 2.62    | 2.27   | 2.05   |
| BGO                | BONNIEGLEN SOUR              | 1.29                     | <-30           | 47.0                       | 875.5           | 18.4  | 12.8    | 9.14    | 6.79   | 6.02   |
| BHB                | BOREALIS HEAVY BLEND         | 3.75**                   | <-30**         | 49.6**                     | 924.9*          | 236**   | 126**   | 74.8**  | 46.6** | 37.2** |
| BR                 | BOW RIVER                    | 2.92                     | <-30           | 38.0                       | 925.5           | 209   | 113     | 66.6    | 41.7   | 33.8   |
| CAL                | CENTRAL ALBERTA PIPELINE     | 1.04                     | -24            | 63.0                       | 844.6           | 7.15  | 5.47    | 4.19    | 3.48   | 3.22   |
| CAM                | AMOCO CONDENSATE             | 0.10                     | <-30           | 66.5                       | 709.5           | 0.653   | 0.590   | 0.533   | 0.490  | 0.470  |
| CBG                | BONNIE GLEN CONDENSATE       | 0.17                     | <-30           | 72.8                       | 715.0           | 0.687   | 0.623   | 0.563   | 0.517  | 0.510  |
| CCA                | CAROLINE CONDENSATE          | 0.41                     | <-30           | 50.0                       | 740.8           | 0.667   | 0.610   | 0.537   | 0.497  | 0.470  |
| CFD                | FEDERATED CONDENSATE         | 0.09                     | <-30           | 83.0                       | 712.1           | 0.737   | 0.663   | 0.603   | 0.553  | 0.575  |
| CFT                | FORT SASKATCHEWAN CONDENSATE | 0.03                     | <-30           | 86.6                       | 674.8           | 0.537   | 0.493   | 0.440   | 0.425  | 0.400  |
| CGB                | GIBSON CONDENSATE            | 0.34                     | <-30**         | 81.3                       | 718.4           | 0.757   | 0.663   | 0.597   | 0.550  | 0.540  |
| CL                 | COLD LAKE                    | 3.70                     | <-30           | 66.0                       | 927.3           | 300   | 156     | 89.1    | 57.1   | 44.8   |
| CPC                | PETROCANADA CONDENSATE       | 0.00                     | <-30           | 50.2                       | 693.1           | 0.490   | 0.443   | 0.407   | 0.380  | Boiled |
| CPM                | PEMBINA CONDENSATE           | 0.25                     | <-30           | 67.8                       | 760.1           | 1.33  | 1.13    | 1.01    | 0.887  | 0.865  |
| CPR                | PEACE PIPE CONDENSATE        | 0.16                     | <-30**         | 81.4                       | 739.2           | 1.30  | 1.09    | 0.940   | 0.833  | 1.10   |
| CRB                | RAINBOW CONDENSATE           | 0.17                     | <-30           | 87.3                       | 739.1           | 1.91  | 1.56    | 1.34    | 1.09   | 1.28   |
| CRM                | RIMBEY CONDENSATE            | 0.16                     | <-30           | 78.8                       | 698.5           | 0.673   | 0.593   | 0.543   | 0.495  | 0.480  |
| CRW                | CONDENSATE BLEND             | 0.14                     | <-30           | 77.6                       | 720.9           | 0.720   | 0.637   | 0.577   | 0.533  | 0.530  |
| CSB                | CHRISTINA LAKE SYN-BIT BLEND | 3.14*                    | <-30**         | 23.4**                     | 935.2*          | 274*  | 144*    | 82.6*   | 50.1*  | 40.6*  |
| ESB                | ECHO SYNTHETIC BLEND         | 3.35**                   | <-30**         | 53.1**                     | 923.9**         | 325**   | 167**   | 96.3**  | 58.3** | 46.2** |
| F                  | FOSTERTON                    | 3.20                     | <-30**         | 23.0*                      | 932.2           | 283   | 148     | 82.5    | 50.2   | 40.0   |
| FD                 | FEDERATED                    | 0.48                     | <-30           | 86.0                       | 822.1           | 5.27  | 4.10    | 3.63    | 2.76   | 2.49   |
| FHM                | FOREIGN HIGH SWEET           | 0.42**                   | -18**          | 37.3**                     | 845.2**         | 11.8**  | 7.50**  | 5.55**  | 4.37** | 3.93** |
| GLS                | GIBSONS LIGHT SOUR FOR SLE   | 1.25                     | <-30           | 63.0                       | 830.3           | 5.98  | 4.63    | 3.57    | 3.08   | 2.77   |
| HO                 | HUSKY OIL                    | 0.70*                    | -3**           | 65.0*                      | 829.3*          | 13.9*   | 6.86*   | 5.02*   | 3.72*  | 3.30*  |
| HSB                | HUSKY SYNTHETIC BLEND        | 0.10                     | <-30           | 50.0                       | 859.8           | 11.1  | 7.88    | 5.87    | 4.51   | 4.00   |
| ISH                | ISH                          | 0.83                     | <-30           | 33.0                       | 855.9           | 15.0  | 10.6    | 7.71    | 5.83   | 5.25   |
| LES                | LEDUC SOUR                   | 0.84*                    | <-30**         | 51.0*                      | 851.6           | 6.33*   | 4.61*   | 3.61*   | 2.96*  | 2.70*  |
| LLB                | LLOYDMINSTER BLEND           | 3.46                     | <-30           | 63.0                       | 924.9           | 267   | 142     | 82.3    | 51.4   | 42.6   |
| LLK                | LLOYDMINSTER KERROBERT       | 3.14                     | <-30           | 45.0                       | 928.8           | 268   | 142     | 82.0    | 50.9   | 41.3   |

\* Results from 2006 Crude Characteristics.

\*\* Results from 2005 Crude Characteristics.

\*\*\* Commodity not moved. Results are prior to 2005 Crude Characteristics.

n/a = Test was not done.

## 2007 Crude Characteristics

| Product Identifier | Crude Type (Long Name)     | Total Sulphur (% by wt.) | Pour Point (C) | Reid Vapour Pressure (kPa) | Density (kg/m3) | Viscosity (cSt) at Specified Temperature (degree Celsius) |       |       |       |       |
|--------------------|----------------------------|--------------------------|----------------|----------------------------|-----------------|---|-------|-------|-------|-------|
|                    |                            |                          |                |                            |                 | 10.00   | 20.00 | 30.00 | 40.00 | 45.00 |
| LSB                | LIGHT SOUR BLEND           | 1.24                     | -20            | 65.4                       | 846.7           | 8.46  | 5.73  | 4.42  | 3.49  | 3.21  |
| M                  | MIDALE BLEND               | 2.27                     | -8             | 52.1                       | 880.2           | 23.0  | 13.6  | 9.10  | 6.61  | 5.90  |
| MBL                | HARDISTY LIGHT             | 1.70                     | <-30**         | 71.0                       | 861.6           | 19.2  | 13.3  | 9.48  | 7.33  | 6.57  |
| MCG                | ICG LIGHT SOUR             | 0.82                     | -9             | 57.0*                      | 840.9           | 9.75  | 5.77  | 4.43  | 3.50  | 3.86  |
| MGL                | GIBSON LIGHT               | 0.46                     | <-30           | 58.2                       | 818.7           | 4.27  | 3.40  | 2.70  | 2.25  | 2.13  |
| MGS                | GIBSON SOUR                | 1.57                     | <-30           | 58.8                       | 825.1           | 4.94  | 3.92  | 3.17  | 2.76  | 2.57  |
| MJT                | MOOSE JAW TOPS             | 1.98                     | -21***         | 38.6***                    | 849.4           | 6.69  | 5.03  | 3.91  | 3.13  | 2.83  |
| MKH                | MACKAY RIVER HEAVY         | 2.73                     | <-30**         | 29.0*                      | 933.8           | 269*  | 140*  | 79.4* | 49.0* | 39.4* |
| MLN                | JOARCAM                    | 0.42                     | -15            | 46.0                       | 824.9           | 7.87  | 5.60  | 4.32  | 3.47  | 3.15  |
| MM                 | MANITOBA MEDIUM            | 2.19                     | -27            | 54.0                       | 880.0           | 18.9  | 12.9  | 8.99  | 6.77  | 6.02  |
| MML                | MANITOBA LIGHT             | 1.43                     | <-30           | 82.0                       | 843.6           | 9.37  | 6.68  | 5.09  | 4.13  | 3.67  |
| MPR                | PEACE PIPE LIGHT           | 0.42                     | -18            | 59.0                       | 822.5           | 5.67  | 4.31  | 3.35  | 2.78  | 2.52  |
| MSM                | WESPUR MIDALE              | 2.33                     | -12            | 59.0                       | 875.4           | 17.6  | 11.9  | 8.46  | 6.40  | 5.80  |
| MSY                | LIGHT SMILEY               | 0.40                     | -9**           | 54.0*                      | 839.3*          | 12.4*   | 5.27* | 4.03* | 3.29* | 3.02* |
| NSA                | PREMIUM NEWGRADE SYNTHETIC | 0.10                     | <-30           | 45.0                       | 853.1           | 7.87  | 5.86  | 4.54  | 3.60  | 3.23  |
| NSB                | NEWGRADE SYNTHETIC BLEND   | 0.26                     | <-30           | 48.0                       | 853.1           | 9.40  | 6.96  | 5.35  | 4.23  | 3.79  |
| NW                 | NORMAN WELLS               | 0.32*                    | <-30**         | 100.0*                     | 820.8*          | 4.80*   | 3.83* | 3.09* | 2.61* | 2.45* |
| OCC                | SUNCOR-CRACKED C           | 3.12                     | <-30           | 7.5                        | 922.3           | 20.0  | 13.0  | 8.98  | 6.55  | 5.69  |
| OSA                | SUNCOR - A                 | 0.21                     | <-30           | 30.0                       | 858.6           | 6.10  | 4.60  | 3.59  | 2.88  | 2.59  |
| OSC                | SUNCOR - C                 | 0.16                     | <-30           | 27.0                       | 876.9           | 15.7  | 10.6  | 7.51  | 5.60  | 4.91  |
| OSH                | SUNCOR-OSH                 | 3.06                     | <-30           | 27.0                       | 932.3           | 117   | 60.3  | 34.7  | 21.7  | 17.6  |
| OSN                | SUNCOR - N                 | 0.01                     | <-30           | 68.7                       | 723.1           | 0.730   | 0.660 | 0.597 | 0.533 | 0.520 |
| OSS                | SUNCOR SYNTHETIC SOUR      | 3.56                     | n/a            | 18.0                       | 923.6           | 25.5  | 15.9  | 10.7  | 7.60  | 6.53  |
| P                  | PEMBINA                    | 0.43                     | -21            | 55.0                       | 827.9           | 6.16  | 4.73  | 3.63  | 2.89  | 2.66  |
| PAS                | PREMIUM ALBIAN SYNTHETIC   | 0.07                     | <-30           | 4.0                        | 858.3           | 7.01  | 5.20  | 4.02  | 3.21  | 2.89  |
| PBS                | PINE BEND SPECIAL          | 3.77                     | <-30           | 25.0                       | 939.1           | 177   | 95.0  | 56.0  | 35.4  | 28.8  |
| PH                 | PEACE HEAVY                | 4.60                     | <-30           | 57.0                       | 926.4           | 222   | 120   | 69.9  | 45.0  | 37.4  |
| RA                 | RAINBOW LIGHT              | 0.45                     | -18            | 70.0                       | 828.1           | 6.18  | 4.72  | 3.63  | 3.05  | 2.78  |
| RW                 | REDWATER                   | 0.44                     | -18            | 76.0                       | 846.1           | 9.96  | 7.23  | 5.42  | 4.38  | 3.89  |
| SC                 | SMILEY COLEVILLE HEAVY     | 2.95                     | <-30           | 40.0                       | 930.7           | 259   | 137   | 80.2  | 49.3  | 39.8  |
| SES                | SOUTH EAST SASK            | 1.24                     | -21            | 68.0                       | 845.3           | 7.40  | 5.58  | 4.33  | 3.55  | 3.12  |
| SH                 | BLACK ROCK SEAL HEAVY      | 4.53                     | <-30           | 46.0                       | 927.6           | 271   | 145   | 84.0  | 52.4  | 43.0  |
| SHE                | EDMONTON HIGH SOUR         | 1.71                     | -26            | 54.8                       | 850.7           | 8.03  | 5.70  | 4.48  | 3.60  | 3.29  |

\* Results from 2006 Crude Characteristics.

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n/a = Test was not done.

## 2007 Crude Characteristics

| Product Identifier | Crude Type (Long Name)       | Total Sulphur (% by wt.) | Pour Point (C) | Reid Vapour Pressure (kPa) | Density (kg/m3) | Viscosity (cSt) at Specified Temperature (degree Celsius) |        |        |        |        |
|--------------------|------------------------------|--------------------------|----------------|----------------------------|-----------------|---|--------|--------|--------|--------|
|                    |                              |                          |                |                            |                 | 10.00   | 20.00  | 30.00  | 40.00  | 45.00  |
| SLE                | EDMONTON LOW SOUR            | 1.05                     | -23            | 54.5                       | 836.7           | 7.31  | 5.41   | 4.39   | 3.53   | 3.25   |
| SO                 | MIXED BLEND SOUR             | 1.67                     | -29            | 71.6                       | 861.6           | 19.2  | 13.3   | 9.48   | 7.33   | 6.57   |
| SPR                | PEACE PIPE SOUR              | 1.96                     | -24            | 45.6                       | 850.4           | 11.4  | 8.46   | 6.38   | 4.99   | 4.10   |
| SSS                | SARNIA SPECIAL               | 0.94                     | 0              | 43.0                       | 878.9           | 176   | 88.0   | 48.2   | 29.8   | 24.3   |
| SSX                | SHELL SYNTHETIC LIGHT        | 0.13                     | <-30           | 20.0                       | 882.4           | 18.8  | 12.4   | 8.73   | 6.44   | 5.61   |
| SW                 | MIXED BLEND SWEET            | 0.40                     | -20            | 63.9                       | 826.7           | 6.19  | 4.54   | 3.58   | 2.93   | 2.74   |
| SYN                | SYNCRUDE                     | 0.13                     | <-30           | 23.0                       | 867.6           | 10.6  | 7.52   | 5.59   | 4.32   | 3.84   |
| UHC                | U.S. HIGH SWEET - CLEARBROOK | 0.33                     | -29            | 65.7                       | 827.9           | 5.60  | 4.43   | 3.55   | 3.00   | 2.79   |
| UHL                | U.S. HIGH SWEET - LEWISTON   | 0.50                     | -7             | 78.7                       | 804.7           | 9.33  | 3.23   | 2.44   | 2.04   | 1.91   |
| UHM                | U.S. HIGH SWEET - MOKENA     | 0.44                     | -29            | 36.9                       | 861.9           | 17.9  | 12.5   | 9.61   | 7.36   | 6.54   |
| UMC                | PORTAL MIDALE                | 2.21                     | -6**           | 43.9*                      | 876.4           | 33.4*   | 15.7*  | 10.1*  | 7.45*  | 6.54*  |
| UOC                | U.S. SOUR - CLEARBROOK       | 2.40                     | 0**            | 38.7                       | 889.7           | 56.5  | 32.1   | 20.4   | 13.3   | 11.4   |
| UOM                | U.S. SOUR - MOKENA           | 0.80                     | -21**          | 43.7**                     | 867.0           | 29.9**  | 19.5** | 13.6** | 10.1** | 8.87** |
| WCB                | WESTERN CANADIAN BLEND       | 3.06                     | <-30           | 42.0                       | 927.5           | 292   | 153    | 87.5   | 53.7   | 43.1   |
| WCS                | WESTERN CANADIAN SELECT      | 3.33                     | <-30           | 63.0                       | 927.3           | 291   | 152    | 87.1   | 53.8   | 43.8   |
| WH                 | WABASCA HVY                  | 4.02                     | <-30           | 47.0                       | 929.4           | 284   | 150    | 86.2   | 53.1   | 43.1   |
| ZA                 | ZAMA                         | 0.38                     | <-30           | 95.0                       | 824.3           | 4.93  | 3.81   | 3.26   | 2.73   | 2.43   |

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