Present status of the BigRIPS cryogenic plant

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In addition to periodic calibration of pressure and temperature sensors, maintaining the oil-removal module in the helium compressor unit is crucial to ensure long-term continuous operations of BigRIPS[1)]. The oil-removal module comprises an oil vessel with a demister (1SP), three coalescer vessels (2SP, 3SP, and, 3.5SP), and two adsorbent vessels (4SP and 5SP). We replaced the activated charcoal and molecular sieves in 4SP every year and the activated charcoal in 5SP every 2 years to ensure low oil contamination in helium gas at the exit of the oil-removal module.

Before the adsorbent vessels, oil in the helium gas is separated by coalescer filters in three coalescer vessels. The drain oil separated from the helium gas is sent to the compressor via a drain line with solenoid valves, depending on the oil level in the coalesce vessel. By measuring the operation interval of the solenoid valves, the oil contamination level of the helium gas at the entrance of the second and the third coalesce vessel can be evaluated. The expected oil contamination levels at the entrance of the coalescer vessels are 15-50 and 0.75-1.25 wt. ppm for 3SP and 3.5SP, respectively. The oil contamination level can also be easily measured with an oil check kit[2)].

Each coalescer vessel contains four coalescer filters, manufactured by Domnick Hunter[3)], and all the filters were replaced every 2 years, since 2008. However, the filters used for 6 years were discontinued and replaced with the successive product of Domnick Hunter in 2014.

Figure 1 shows an estimate of the oil contamination level at the entrance of 3SP as a function of the coalescer filter operation time from the oil drain from the 3SP. The navy blue, green, and, yellow diamonds represent the estimates for the 2008-2009, 2010-2011, and 2012-2013 operations, respectively. The estimate for the 2014 operation with new coalescer filters is shown as pink diamonds. The estimates increase to 50~75 wt. ppm up to an operation time of 2000 hours for the period of 2008-2009 and 2010-2011 and then stays constant. The estimate for the 2014 operation shows similar behavior. On the other hand, the estimate for the period of 2012-2013 scatters largely and shows monotonous increasing tendency. The oil check kit values are also shown as open symbols in Fig. 1. The open triangles, squares, circles, and diamonds represent results for the 2008-2009, 2010-2011, 2012-2013, and 2014 operations, respectively.

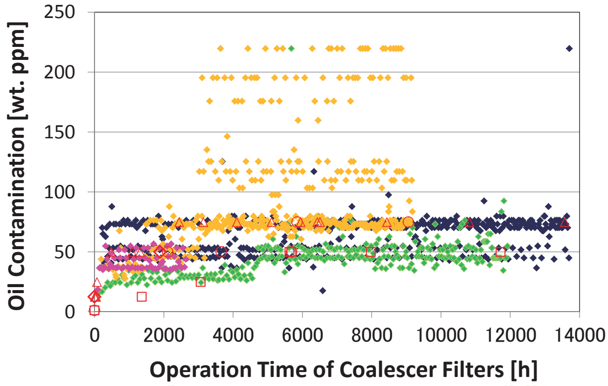

Fig. 1. Oil contamination at the entrance of the second coalescer vessel (3SP).

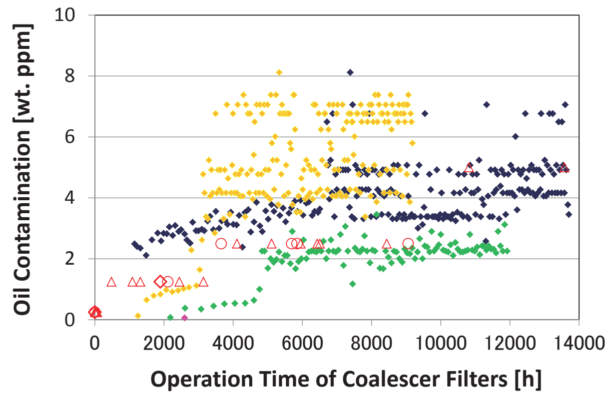

Fig. 2. Oil contamination at the entrance of the third coalescer vessel (3.5SP).

In Fig. 2, we show a similar analysis of the oil contamination at the entrance of 3.5SP. Symbols and colors used in Fig. 2 are same as those in Fig. 1. A gradual increasing tendency of the oil contamination is seen in all operation periods. Following the large oil contamination at the entrance of the 3SP, the results for the period of 2012-2013 are approximately twice of that for the other period. Since the solenoid valve of 3.5SP was operated only once since Sept. 2014, only one pink symbol is plotted in Fig. 2. Although the performance efficiency of the new filter elements seem to be similar to that of discontinued ones, we shall continue observations and investigate oil-removal modules carefully in the coming maintenance period.

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References
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3) http://www.parker.com/