Present status of the BigRIPS cryogenic plant

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Periodic maintenance of the BigRIPS cryogenic plant is essential to ensure long-term continuous operations of BigRIPS. In addition to periodically calibrating the pressure and temperature sensors installed in the system, maintaining the oil-removal module in the helium compressor unit is crucial[1]. The oil-removal module comprises an oil vessel with a demister, which is used as a bulk oil separator (1SP), three coalescer vessels (2SP, 3SP, and, 3.5SP), and two adsorbent vessels (4SP and 5SP) that contain activated charcoal and molecular sieves. The periodic replacement of coalescer filters and adsorbents ensure the small oil contamination in helium gas. The contamination ranges between 0.008 - 0.02 weight ppm (wt. ppm), depending on the quality of the coalescers used.

We replaced all the coalescer filters in three coalescer vessels during the summer maintenance in 2008, 2010, and 2012. Each coalescer vessel contains four coalescer filters, manufactured by Domnick Hunter[3], and 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 vessel. The expected oil contamination levels at the exit 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 be easily measured with an oil check kit[2].

Figure 1 shows the contamination measured at the entrance of 3SP as a function of the coalescer filter operation time. The oil check kit values are shown as open symbols in Fig. 1. The open triangles, squares, and circles represent results for the 2008-2009, 2010-2011, and 2012 operations, respectively. An estimate from the oil drain from the 3SP is also shown in Fig. 1. We estimate the oil contamination level by measuring the operation interval of the solenoid valve installed in 3SP. The navy blue, green, and, yellow diamonds represent the estimates for the 2008-2009, 2010-2011, and 2012 operations, respectively. The estimates of oil drain increase to 50~75 wt. ppm up to an operation time of 2000 h for the period of 2008-2009 and 2010-2011 and then stays constant. Corresponding oil check kit results show a similar increasing tendency. On the other hand, the estimate from the oil drain for the period of 2012 shows monotonous increasing tendency and does not stay constant for any long period. We shall continue observations in the next operation. This difference indicates the performance efficiency of different coalescer filters.

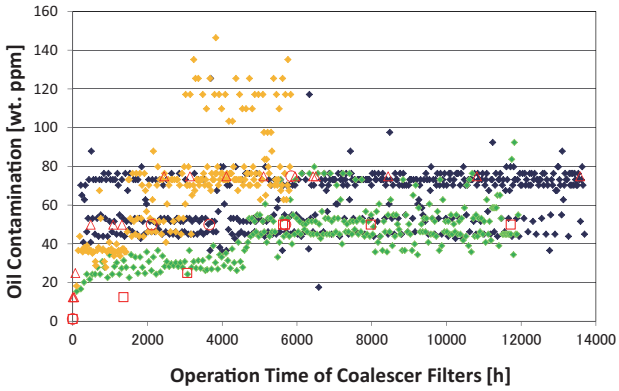

Fig. 1. Oil contamination at the entrance of the second coalescer vessel (3SP).

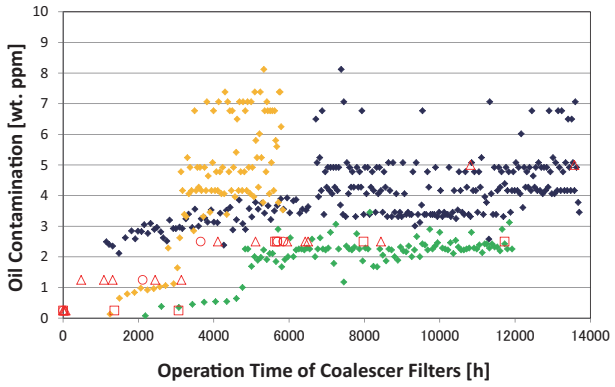

Fig. 2. Oil contamination at the entrance of the third coalescer vessel (3.5SP).

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 less oil contamination at the entrance of the 3SP, the results for the period of 2010-2011 are approximately half of that of the other period. However, the oil contamination estimated from the oil drain for the period of 2012 unexpectedly increased faster than other periods. We shall continue observations in the next operation and investigate the coalescer filters in the maintenance planned in the summer of 2014.

References

1) K. Kusaka et al.: RIKEN Accel. Prog. Rep. **41**, 244 (2008).
2) K. Kusaka et al.: RIKEN Accel. Prog. Rep. **43**, 309 (2010).
3) http://www.parker.com/

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