Present status of the BigRIPS cryogenic plant

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Periodic maintenance of the helium compressor unit is crucial to ensure long-term continuous operations of BigRIPS[1)]. Since the total operation time of the helium compressor unit has reached to 52,060 h in July 2015, the main compressor and the motor unit were shipped to the manufacturer's factory for maintenance. The compressor unit was disassembled and its interior was cleaned. All the components were checked carefully and no significant mechanical damage was found. They were reassembled with new mechanical seals and bearings.

The main motor unit was also disassembled. The rotor and the stator coils were cleaned and varnished. The abrasion of the size of +30–50 μm was found at the anti-coupling side bearing bracket. The bracket was repaired by the bushing method, so that its surface became highly smooth (+7–10 μm) and a new motor bearing could be installed. In addition to mechanical checks electrical properties of the motor unit were successfully tested. The rebuilt compressor and main motor unit were installed on site in September.

In September 2014 we have started the continuous operation of the BigRIPS cryogenic plant and stopped the main compressor in July 2015. After the summer maintenance, we started the cryogenic plant in mid−September and stopped the compressor in December 2015. During these continuous operations, we faced some troubles on the compressor unit. One is an unusual noise that was produced by the main motor unit in May 2015. We greased the motor unit and maintained the continuous operation. In other incidents, the compressor unit suddenly stopped that happened twice in May 2015. The failure of the temperature transducer for the discharge helium gas caused false interlock stops. We replaced the temperature transducer and continued the operation. After these incidents, we have started measuring the vibrations of the main compressor unit for sound operations.

Figure 1 shows the vibration velocities in the axial and vertical directions as a function of the total operation time. We measured vibrations both at the high-pressure (HP) and low-pressure (LP) sides of the main compressor unit using the handy vibration tester OH-580A[4)]. It is clearly seen that the vibration velocity changed drastically before and after the maintenance.

In addition to maintaining the mechanical components of the compressor unit, we replaced the activated charcoal and molecular sieves in the adsorbent vessel in August 2015. We observed the oil contamination level of the oil-removal module using an oil check kit.

Figure 2 shows an estimate of the oil contamination level at the entrance of the third coalescer vessel as a function of the coalescer filter operation time. As stated by Kusaka et al.[2)], the amount of oil drain from the vessel is directly related to the oil contamination level. The navy blue, green, and, yellow diamonds represent the estimates for the 2008-2009, 2010-2011, and 2012-2013 operations, respectively. The coalescer filters used in those periods were discontinued[3)]. The estimate for the 2014-2015 operation with successive new coalescer filters is shown as pink diamonds. The oil contamination measurement values using the oil check kit are also shown. The open triangles, squares, circles, and diamonds represent the results for the 2008-2009, 2010-2011, 2012-2013, and 2014-2015 operations, respectively. The performance efficiency of the new filter elements seems to be similar to or better than that of the discontinued ones.

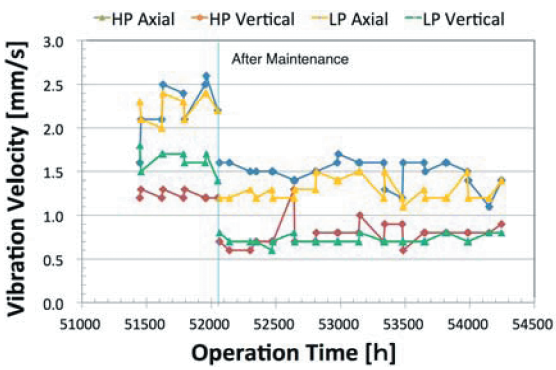

Fig. 1. Vibration velocity of the compressor unit.

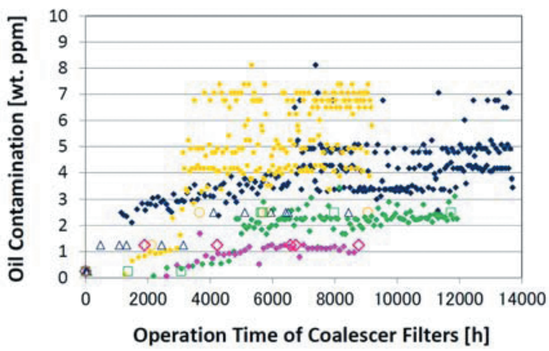

Fig. 2. Oil contamination at the entrance of the third coalescer vessel.

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References
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4) http://www.testo.jp.