Survey of Perfluorinated Compounds in the Environmental Water in Okinawa
(Result of Summer Survey in Fiscal Year 2018)

Results of Survey
The Okinawa Prefectural Government (OPG) has been conducting a survey of perfluorinated compounds in the environmental water of the prefecture since August 2016 in order to assess perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) levels in groundwater. The results of the most recent analysis of 16 samples from various sites (See Appendix 1) are listed in Appendix 2. The detected values of perfluorinated compounds in these samples were almost the same as the results of a previous survey, although there was some fluctuation. There are no standards set for perfluorinated compounds in water in Japan, however the total concentration levels of PFOS and PFOA at 6 out of 16 samples in groundwater around Marine Corps Air Station (MCAS) Futenma were found to have exceeded lifetime health advisory levels for drinking water in the United States (hereinafter referred to as “recommended levels”).

Furthermore, in this survey, 6:2FTS and 8:2FTS which were reported to be decomposed and generated from fire extinguishing foam were also measured. As a result, it was confirmed that in some of the points where PFOS and PFOA concentration exceeded the recommended value; it was detected at higher concentrations than at other points. This suggested the influence of fire extinguishing foam extinguishing agent on groundwater. From this fact, it is considered that at some points, the probability that PFOS and PFOA detected beyond the recommended value is more likely to be fire extinguishing foam used in airports, etc.

The levels detected are not considered to be a problem as long as residents do not drink the groundwater directly. In this summer survey, OPG conducted sampling and analysis of surface water around MCAS Futenma; it was confirmed that the concentration of PFOS and PFOA in surface water flowing into the air station is low. OPG will continue to monitor relatively high concentration points to assess the situation.

The lifetime health advisory levels for drinking water is calculated assuming that 2 liters of drinking water per day is drunk for 70 years and exposed to chemical substances. PFOS, PFOA combined to a concentration of 70 ng / L, it is considered that there is no health impact even if you continue drinking for the lifetime (70 years).
Reference Material

The standards of PFOS and PFOA

○ Japan (There are no standards.)
  Ministry of Health, Labor and Welfare: Items should be examined in regards to tap water (2009)
  Desired amount has not been set both on PFOS or PFOA

  Ministry of Environment: Items which require research for programs on conservation of aquatic environment (March, 2014)
  Although PFOS and PFOA are marked to be researched, neither standards nor advisories among others are set.

○ The United States
  Lifetime Health Advisories in drinking water
  2016: Total amount of PFOS and PFOA 70 ng/L

○ Germany
  Lifetime Health Advisories in drinking water
  2006: Total amount of PFOS and PFOA 300 ng/L

About PFOS and PFOA

○ PFOS stands for Perfluor Octane Sulfonate while PFOA stands for Per Flouro Octanoic Acid. Both of them are one of organofluorine compounds. Because PFOS and PFOA possess hydrophobicity nature (a feature to repel water) and oleophobicity nature (a feature to repel oil), they had been widely used for fire extinguishing foam, water repellents and antifouling agents, etc.

○ PFOS is mainly used for fire extinguishing foam, plating solution, aircraft hydraulic oil, water repellent and floor wax, etc. However, the authorized use of PFOS is currently limited to production of etching solutions, semiconductor resist, and business purpose photographic films as the essential use which cannot be replaced with substitutes. The use of PFOS for any other purposes than those mentioned above are prohibited. However, the use of PFOS in all products is prohibited in Japan from April 2018. PFOA is used for producing fluoroplastics. It has not been a target of regulation at the present moment, however it is expected to be regulated in the same way as PFOS in the future. Please note that fire extinguishing foam is not subject to essential use of PFOS, however the use of PFOS for fire extinguishing foam is permitted on the condition that its producers must set the technical standards in handling PFOS and make them public in order to prevent the environment of pollution. However, it is recommended to replace it with substitutes.

○ PFOS and PFOA hardly decompose in the environment. Therefore, its persistence in the environment as well as its accumulation in living organisms are considered to be problematic and have been object to regulation as new environmental pollutants. Following that Lifetime Health Advisories in regard to
drinking water in the U.S. is now based on the total of PFOA and PFOS, research should be conducted on these two substances.

About 6:2FTS and 8:2FTS

- 6:2FTS stands for 1H, 1H, 2H, 2H-perfluoro octane sulfonate while 8:2FTS stands for 1H, 1H, 2H, 2H-perfluoro decane sulfonate. These substances were reported to be decomposed and generated from fire extinguishing foam in the presence of oxidizing agent*1. Based on this fact, if 6:2FTS and 8:2FTS are detected in groundwater surrounding the air station, it is suggested that the groundwater may be affected by fire extinguishing foam. (Fire extinguishing foam is held at the base to cope with aircraft fires.)

Sampling Points

Appendix 1

Legend
PFOS+PFOA Detected
ng/L (ppt)

\( n \leq 70 \)

\( n > 70 \)

Okinawa Island

Legend
PFOS+PFOA Detected
ng/L (ppt)

\( n \leq 70 \)

\( n > 70 \)
## Result of Winter Survey in Fiscal Year 2017

### Analysis Items
- Perfluorooctane sulfonate (PFOS)
- Perfluorooctanoic Acid (PFOA)
  - 1H,1H,2H,2H-Perfluorooctane sulfonate (6:2FTS)
  - 1H,1H,2H,2H-Perfluorooctanoic Acid (8:2FTS)

### Subject
- Water quality

### Result List

<table>
<thead>
<tr>
<th>Municipality</th>
<th>Location</th>
<th>Subject</th>
<th>PFOS (ng/L)</th>
<th>PFOA (ng/L)</th>
<th>Total (ng/L)</th>
<th>PFOS (ng/L)</th>
<th>PFOA (ng/L)</th>
<th>Total (ng/L)</th>
<th>PFOS (ng/L)</th>
<th>PFOA (ng/L)</th>
<th>Total (ng/L)</th>
<th>PFOS (ng/L)</th>
<th>PFOA (ng/L)</th>
<th>Total (ng/L)</th>
<th>PFOS (ng/L)</th>
<th>PFOA (ng/L)</th>
<th>Total (ng/L)</th>
<th>PFOS (ng/L)</th>
<th>PFOA (ng/L)</th>
<th>Total (ng/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chatan Town</td>
<td>Surrounding area of Camp Zukeran, Western Drainage</td>
<td>Winter Survey (JFY2016)</td>
<td>30</td>
<td>11</td>
<td>41</td>
<td>57</td>
<td>7.5</td>
<td>64</td>
<td>29</td>
<td>9.1</td>
<td>38</td>
<td>30</td>
<td>8.0</td>
<td>38</td>
<td>27</td>
<td>8.3</td>
<td>35</td>
<td>5.4</td>
<td>1.4</td>
<td></td>
</tr>
<tr>
<td>Ginowan City</td>
<td>Surrounding area of Futenma Air Station, Chunnaga (spring)</td>
<td>Winter Survey (JFY2016)</td>
<td>1200</td>
<td>190</td>
<td>1390</td>
<td>730</td>
<td>150</td>
<td>880</td>
<td>740</td>
<td>140</td>
<td>880</td>
<td>800</td>
<td>130</td>
<td>1000</td>
<td>1800</td>
<td>200</td>
<td>2000</td>
<td>390</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Ginowan City</td>
<td>Surrounding area of Futenma Air Station, Hushihiga (spring)</td>
<td>Winter Survey (JFY2016)</td>
<td>38</td>
<td>21</td>
<td>59</td>
<td>39</td>
<td>22</td>
<td>61</td>
<td>37</td>
<td>25</td>
<td>62</td>
<td>39</td>
<td>22</td>
<td>61</td>
<td>39</td>
<td>22</td>
<td>62</td>
<td>4.4</td>
<td>0.4</td>
<td></td>
</tr>
<tr>
<td>Ginowan City</td>
<td>Surrounding area of Futenma Air Station, Hiyakaga (spring)</td>
<td>Winter Survey (JFY2016)</td>
<td>180</td>
<td>31</td>
<td>210</td>
<td>94</td>
<td>26</td>
<td>120</td>
<td>94</td>
<td>26</td>
<td>120</td>
<td>94</td>
<td>26</td>
<td>120</td>
<td>94</td>
<td>26</td>
<td>120</td>
<td>75</td>
<td>8.9</td>
<td></td>
</tr>
<tr>
<td>Ginowan City</td>
<td>Surrounding area of Futenma Air Station, Mendakarihiga (spring)</td>
<td>Winter Survey (JFY2016)</td>
<td>680</td>
<td>35</td>
<td>710</td>
<td>670</td>
<td>42</td>
<td>710</td>
<td>590</td>
<td>43</td>
<td>630</td>
<td>640</td>
<td>42</td>
<td>680</td>
<td>600</td>
<td>50</td>
<td>650</td>
<td>150</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>Ginowan City</td>
<td>Surrounding area of Futenma Air Station, Morinokawa (spring)</td>
<td>Winter Survey (JFY2016)</td>
<td>30</td>
<td>9.4</td>
<td>39</td>
<td>40</td>
<td>5.4</td>
<td>45</td>
<td>39</td>
<td>11</td>
<td>50</td>
<td>71</td>
<td>25</td>
<td>94</td>
<td>46</td>
<td>6.4</td>
<td>52</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td></td>
</tr>
<tr>
<td>Ginowan City</td>
<td>Surrounding area of Futenma Air Station, Samasihita Ubusa (spring)</td>
<td>Winter Survey (JFY2016)</td>
<td>24</td>
<td>9.0</td>
<td>33</td>
<td>30</td>
<td>11</td>
<td>41</td>
<td>18</td>
<td>8.8</td>
<td>26</td>
<td>13</td>
<td>7.2</td>
<td>20</td>
<td>25</td>
<td>9.9</td>
<td>34</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td></td>
</tr>
<tr>
<td>Ginowan City</td>
<td>Surrounding area of Futenma Air Station, Isaufuga (spring)</td>
<td>Winter Survey (JFY2016)</td>
<td>130</td>
<td>62</td>
<td>190</td>
<td>120</td>
<td>35</td>
<td>150</td>
<td>250</td>
<td>42</td>
<td>290</td>
<td>220</td>
<td>60</td>
<td>280</td>
<td>17</td>
<td>14</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ginowan City</td>
<td>Surrounding area of Futenma Air Station, Furuchinga (spring)</td>
<td>Winter Survey (JFY2016)</td>
<td>98</td>
<td>22</td>
<td>120</td>
<td>66</td>
<td>17</td>
<td>83</td>
<td>49</td>
<td>14</td>
<td>63</td>
<td>30</td>
<td>11</td>
<td>41</td>
<td>21</td>
<td>0.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ginowan City</td>
<td>Surrounding area of Futenma Air Station, Aragusuku A (groundwater)</td>
<td>Winter Survey (JFY2016)</td>
<td>15</td>
<td>4.4</td>
<td>19</td>
<td>17</td>
<td>4.8</td>
<td>21</td>
<td>15</td>
<td>4.3</td>
<td>19</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ginowan City</td>
<td>Surrounding area of Futenma Air Station, Kyuna A (groundwater)</td>
<td>Winter Survey (JFY2016)</td>
<td>280</td>
<td>28</td>
<td>280</td>
<td>320</td>
<td>29</td>
<td>340</td>
<td>280</td>
<td>24</td>
<td>300</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ginowan City</td>
<td>Surrounding area of Futenma Air Station, Kyuna B (groundwater)</td>
<td>Winter Survey (JFY2016)</td>
<td>40</td>
<td>31</td>
<td>71</td>
<td>34</td>
<td>23</td>
<td>57</td>
<td>76</td>
<td>72</td>
<td>140</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ginowan City</td>
<td>Surrounding area of Futenma Air Station, In Civic Park (Upstream Surface-Water)</td>
<td>Winter Survey (JFY2016)</td>
<td>6.8</td>
<td>3.8</td>
<td>10</td>
<td>11</td>
<td>4.6</td>
<td>15</td>
<td>6.9</td>
<td>3.9</td>
<td>10</td>
<td>6.8</td>
<td>4.1</td>
<td>10</td>
<td>0.2</td>
<td>&lt;0.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ginowan City</td>
<td>Surrounding area of Futenma Air Station, Ginowan Kumiyabu Ritual Site (spring)</td>
<td>Winter Survey (JFY2016)</td>
<td>7.2</td>
<td>3.9</td>
<td>11</td>
<td>6.7</td>
<td>3.0</td>
<td>9.7</td>
<td>11</td>
<td>5.5</td>
<td>16</td>
<td>6.2</td>
<td>3.5</td>
<td>9.7</td>
<td>9.4</td>
<td>3.4</td>
<td>12</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td></td>
</tr>
<tr>
<td>Ginowan City</td>
<td>Surrounding area of Futenma Air Station, Akamichi (Upstream Surface-Water)</td>
<td>Winter Survey (JFY2016)</td>
<td>12</td>
<td>4.1</td>
<td>16</td>
<td>11</td>
<td>5.1</td>
<td>16</td>
<td>7.8</td>
<td>4.7</td>
<td>12</td>
<td>13</td>
<td>4.9</td>
<td>17</td>
<td>0.2</td>
<td>&lt;0.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Note) The results of measurement are shown in two effective digits (disregarding the third digit) in accordance with "Designation of Water Type in Environmental Standards Based on the Environmental Basic Law and Processing Standards Including Continuous Monitoring Based on the Water Pollution Prevention Act (Ref. 130271 of March 27, 2013)." When the total value was below the lowest detectable limit, the detectable value, 0.04ng/L is used to calculate the value.

(Note) Regarding past measurement results, only the survey measurement points in FY2018 are shown.