Looseness-free Nut "YURUMANAITTO"*

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1 Introduction
A large number of bolts and nuts, of all sizes are used in tightening in steelmaking plants, which are operated under a great vibration. As much as approximately 15% of equipment troubles is caused by looseness of bolts and nuts. Many efforts have been made in order to prevent from loosening bolts and nuts. As one of their fruits, a novel type of looseness-free nut, "YURUMANAITTO" has been successfully developed and commercialized. "YURUMANAITTO" possesses superior features, such as excellent workability and sound for looseness prevention.

2 Structure of YURUMANAITTO
YURUMANAITTO comprises a mother nut and an inner nut, as shown in Fig. 1. The appearance of an M20 nut is shown in Photo 1. Structural features of these nuts are as follows: (1) A washer is united the bottom surface of the mother nut in order to prevent from forming face coves; (2) a looseness prevention function is imparted by giving an eccentricity $\delta$ to the inner nut; (3) the upper part of the mother nut is caulked to prevent separation of the inner nut; and (4) the upper part of the inner nut is provided with a small clearance in order to ensure smooth tightening from the mother nut to the inner nut during bolt tightening.

3 Features of YURUMANAITTO
(1) The reliability of the looseness prevention function is high.
(2) One-step tightening is possible, offering good workability (prevailing-torque value satisfies the value specified in JIS B1056.)
(3) The nut can be reused (prevailing-torque value after the nut is used five times satisfies the value specified in JIS B1056.)
(4) Eight strength classes are adopted as standard (material: S45C-H).
(5) Because the nut is provided with a washer, no hard washer is required, leading to good workability.
(6) The looseness prevention effect can be maintained even if the caulked upper position becomes corroded and separates.

4 Nut Sizes and Prevailing-Torque Value
The available size range of YURUMANAITTO and corresponding prevailing-torque values for each nut size are shown in Table 1.

5 Results of Looseness Evaluation Test of YURUMANAITTO
Figure 2 shows the results of a high-frequency vibra-

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Table 1 Nut size and prevailing torque

<table>
<thead>
<tr>
<th>Size</th>
<th>H</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>Weight (g)</th>
<th>Prevailing torque (Nm)</th>
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</thead>
<tbody>
<tr>
<td>M12</td>
<td>15</td>
<td>22</td>
<td>23</td>
<td>23</td>
<td>50</td>
<td>19–20</td>
</tr>
<tr>
<td>M16</td>
<td>19</td>
<td>27</td>
<td>31</td>
<td>31</td>
<td>100</td>
<td>11–23</td>
</tr>
<tr>
<td>M20</td>
<td>22</td>
<td>32</td>
<td>37</td>
<td>37</td>
<td>130</td>
<td>14–28</td>
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<tr>
<td>M24</td>
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<td>41</td>
<td>47</td>
<td>47</td>
<td>210</td>
<td>17–35</td>
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<tr>
<td>M30</td>
<td>34</td>
<td>50</td>
<td>57</td>
<td>57</td>
<td>430</td>
<td>20–40</td>
</tr>
</tbody>
</table>

![Graph showing the results of the nut loosening test](image)

![Diagram of vibration test apparatus](image)

Fig. 2 Results of the nut loosening test

Fig. 3 Details of vibration test apparatus

(c) Material of nuts of different type: S45C-H
(d) Nut-tightening torque: Set so that the stress on the effective thread of the bolt is almost equal to the yield point of the material × 0.7.

6 Coated Nuts with Environmental Resistance

A PTFE-coated bolt/nut that is effective against bimetallic corrosion, a dacrom-coated nut capable of extending life to two to three times the life time of a general electroplated nut, and other types are also available. Photo 3 to 5 show a chromate-coated nut, a dacrom-coated bolt/nut, and a PTFE-coated bolt/nut, respectively.

7 Conclusion

At Kawasaki Steel, the causes of nut looseness were
analyzed from examples of troubles in bolts and nuts used in steelmaking plants. A new type of looseness-free nut that is remarkably effective in preventing looseness and has good workability, named YURUMANAITTO, was brought to the commercial stage. At present, this type of nuts are used at Mizushima Works, Chiba Works, and Chita Works of Kawasaki Steel and has reduced trouble ascribed to looseness of bolts and nuts.

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