Estimated Wear Amount of Oilless Bearing for Designing Transfer Elevator

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1. Introduction

The transfer elevator is structure and equipment to transport the FM (Fission Molybdenum) target, RI (Radioisotope) target, and FNI (Fast Neutron Irradiation) rig from the spent fuel storage pool to the transfer hot cell. The target or rig is loaded into the transfer basket, and then transfer basket is inserted into the basket holder having wheels. In this study, the estimated wear amount of oilless bearing for the basket holder is calculated and checked for applicability of the bearing.

2. Methods and Results

Figure 1 shows the transfer elevator and basket holder moving along the guide rails.

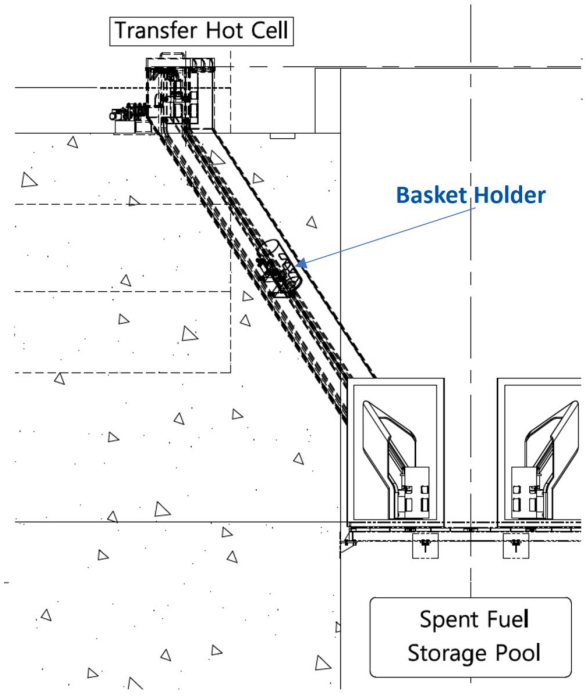

Fig. 1. Transfer elevator and basket holder

The estimated wear amount is calculated using a specific wear amount actually obtained in an experiment. Consider the sliding block depicted in Figure 2, moving along a plate with contact pressure P acting over area A, in the presence of a coefficient of sliding friction f_s [1].

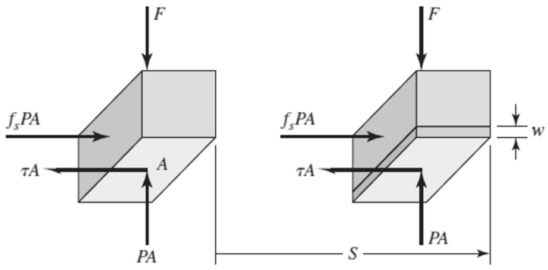

Fig. 2. Sliding block subjected to wear [1]

The work done by force $f_s \cdot P \cdot A$ during displacement S is $f_s \cdot P \cdot A \cdot S$ or $f_s \cdot P \cdot A \cdot V \cdot t$, where V is the sliding velocity and t is time [1]. The material volume removed due to wear is $w \cdot A$ and is proportional to the work done, that is, $w \cdot A \propto f_s \cdot P \cdot A \cdot V \cdot t$, or

$$w \cdot A = K \cdot P \cdot A \cdot V \cdot t \quad (1)$$

where K is the proportionality factor, which includes f_s, and is determined from laboratory testing [1]. A wear calculation formula [1, 2] obtained from the experiment is as follows:

$$w = K \cdot P \cdot V \cdot t \quad (2)$$

w = estimated wear amount, mm
K = specific wear amount, mm/(kgf/cm^2·m/min·hr)
P = load per unit of projected bearing area, kgf/cm^2
V = bearing sliding velocity, m/min
t = sliding hours, hr

Table I shows the calculation inputs and results for estimated wear amount of an oilless bearing.

Table I: Calculation Inputs and Results

Variable	Value
K	1.0E-08 [2]
P	3.68
V	10
t	400
w per one bearing	1.47E-04

From the calculation results, the estimated wear amount is not large [1] during design life, so the bearing

can be applied. The scope of application can be determined from the Catalog [2] so as not to exceed the PV value (36.8 (kgf/cm^2)·(m/min)), which is an important requirement for selecting bearings.

3. Conclusions

In this study, the estimated wear amount of one oilless bearing for designing transfer elevator is calculated and the value is not large during design life. Therefore, the bearing is applicable, but the applicability should be reviewed in consideration of the material and usability for a research reactor in the detailed design stage.

ACKNOWLEDGEMENTS

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[2] SGO Oilless Bearing Catalog, SGO. Co., Ltd, 2022.