NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

DEPARTMENT OF Metallurgical & Materials Engineering

REPORT

TITLE High stress abrasive wear behaviour upto sliding distance of 25 m

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Section - Year 4th (2023)

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Date of Experiment 4/8/2023

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14/08/23

High stress abrasive wear behaviour upto 25m

→ Abrasive wear occurs when a hard rough surface slides across a softer surface

→ ASTM international defines it as the loss of material due to hard particles or hard protuberances that are forced against and move along a solid surface

→ Abrasive wear is commonly classified according to the type of contact and the contact environment

→ The type of contact determines the mode of abrasive wear. 2 modes: two-wear & three w

(a) Two body wear: occurs when the grits or hard particles remove material from the opposite surface. The common analogy is that of material being removed or displaced by a cutting or ploughing operation

(b) Three body wear: occurs when the particles are not constrained, and are free to roll and slide down a surface.

→ The contact environment determines whether the wear is classified as open or close

Open contact environment: occurs when the surfaces are sufficiently displaced to be independent of one another

→ There are a number of factors which influence abrasive wear and hence the manner of material removal.

→ Several different mechanisms have been proposed to describe the manner in which the material is removed.

→ 3 commonly identified mechanisms of abrasive wear are:

- (a) Ploughing
- (b) Cutting
- (c) Fragmentation

(*) Ploughing: occurs when the material is displaced to the side, away from wear particles, resulting in the formation of grooves that do not involve direct material removal.

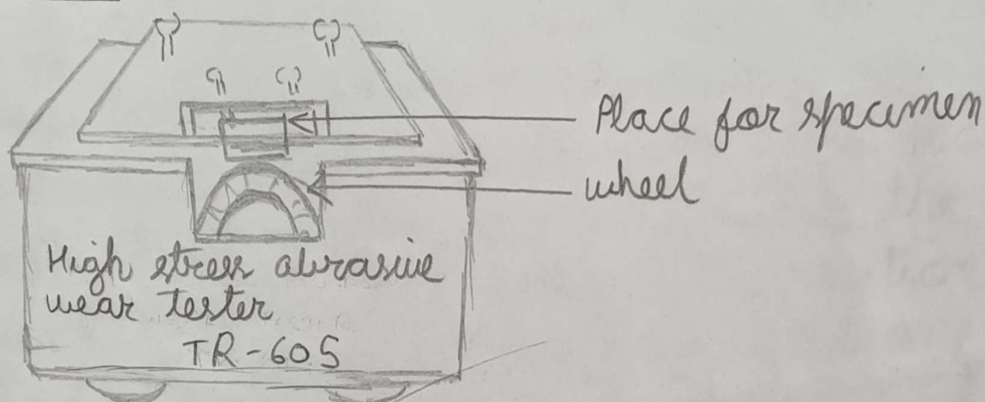
(*) Cutting: occurs when material is seperated from surface in the form of primary debris, or microchips, with little or no material displaced to the side of the grooves

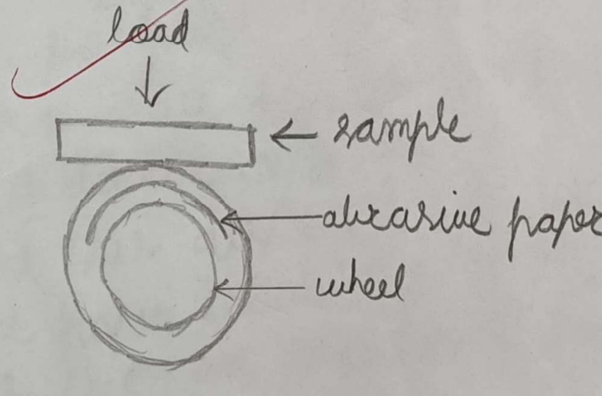
(*) Fragmentation: occurs when a material is seperated from surface by a cutting process and the indenting abrasive causes localized fracture of wear material

Materials required:

→ Steel sample
→ Emery paper
→ 2 body abrasion tester

Diagram:





Experimental Procedure:

→ High-stress (two-body) wear tests are performed on metallographically polished rectangular specimens (size: 50mm × 35mm × 4mm) using a DUCOM TR-605 abrasion tester.

→ Emery papers of different grades (220 or 600 or any other grades) are used to press the samples against the abrasive medium with the help of a cantilever loading mechanism.

→ The specimens experience to-and-fro motion against the abrasive particles while the abrasive wheel also changes its position by the time the specimen has completed one cycle.

→ This enables the samples to encounter fresh abrasive particles (in each cycle) prior to traversing 400 cycles (corresponding to a sliding distance of 25 m).

→ Beyond this distance, the prior degraded abrasive paper is used to abrade the pre-worn surfaces (i.e.: on the same wear track of the samples).

→ Abrasive wear tests are conducted for different number of cycles like 400, 800, 1200, 1600, 2000 and 2400 cycles corresponding to sliding distances of 25, 50, 75, 100, 125 and 150 m respectively

→ A fixed rpm of 40 was maintained in each test.

→ The tests are performed with varying applied loads for different grades (220, 600 etc.) of emery paper.

→ The specimens are cleaned in acetone prior to and after the wear tests and weighed using a Sartorius microbalance, with ± 0.01 mg accuracy.

→ The wear rate (volume loss/sliding distance) is been calculated from the weight loss measurment by dividing the weight loss with density of the sample and corresponding sliding distance.

→ wear resistance is reciprocal of wear rate

Observations and calculation:

→ Initial weight = 72.1181 g

→ Final weight = 72.1091 g

→ Weight loss = (72.1181 − 72.1091) g = 0.009 g

→ Wear rate $= \dfrac{\text{Volume loss}}{\text{Sliding distance}} = \dfrac{0.009}{\rho_{steel} \times 25}$ m^3/m

$$= \frac{0.009\,g}{7.8\,g/cm^3 \times 25\,m} = 4.6 \times 10^{-5}\ cm^3/m$$

$\times 10^{-6}$