

Chapter 6
Third body

MSE 485
Tribology

1 Concept

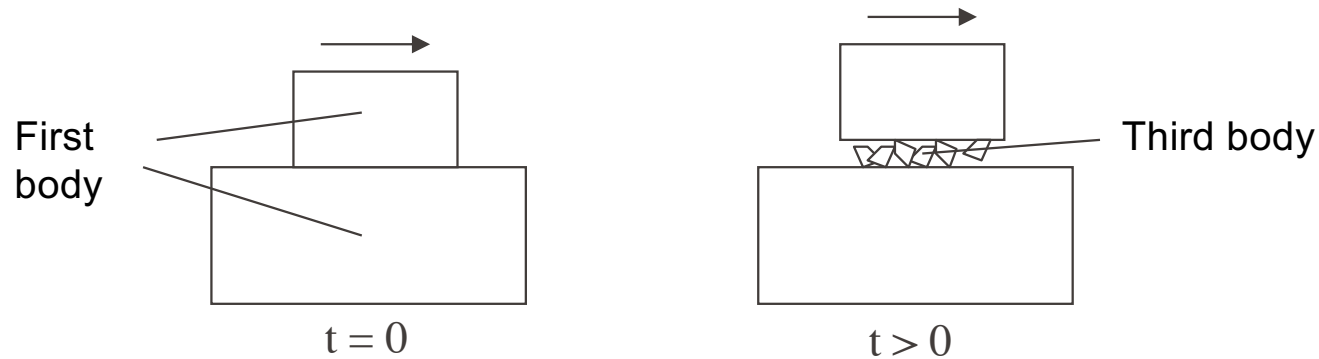
2 Experimental evidence

3 Wear as sequence of material flows

4 The tribological triplet

Zambelli & Vincent Ch. 1 et 4

Concept (Godet 1984, Berthier 1988)



- During friction between the two bodies, particles detach from them and accumulate to generate a third body between the first two ones.
- This third body then regulates the wear process and the behavior of the materials during friction.

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Experimental evidence (I)

- Formation of iron oxide debris (red colour) in the contact zone after friction of a hardened steel ball against a tempered steel disc (load 0.5 N, 1000 rpm, moist air).

ball



disc

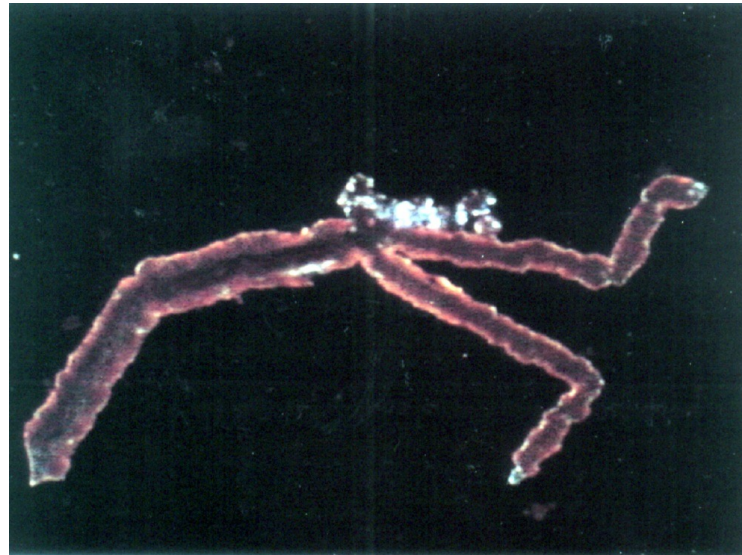


0.5 mm



Experimental evidence (II)

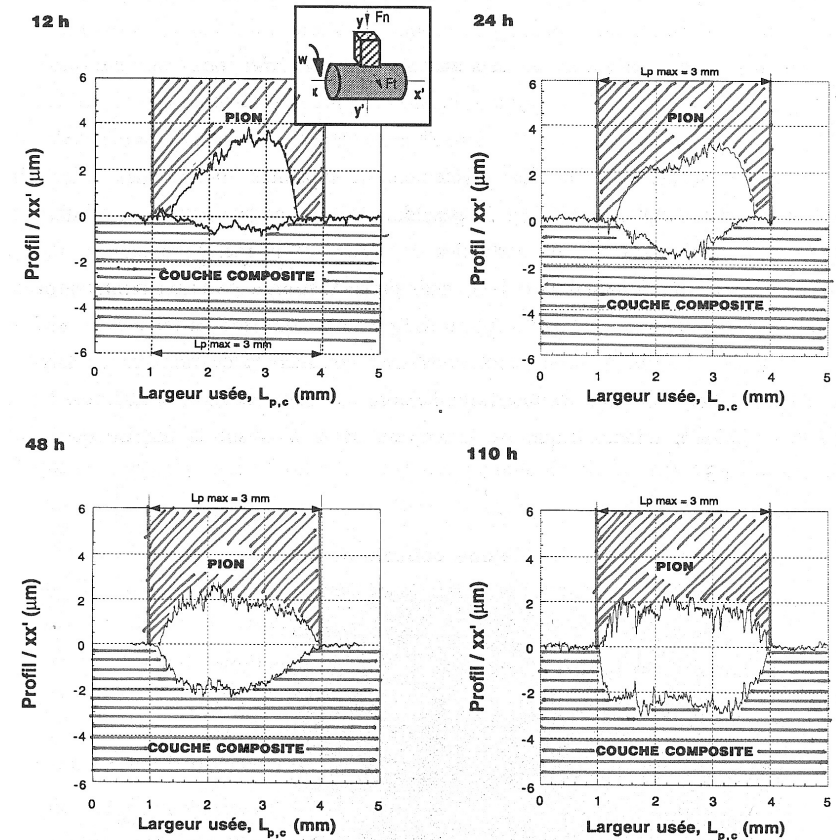
- Wear debris after friction of a hardened steel ball against a tempered steel disc (load 0.5 N, 10 rpm, moist air).



2.16 mm

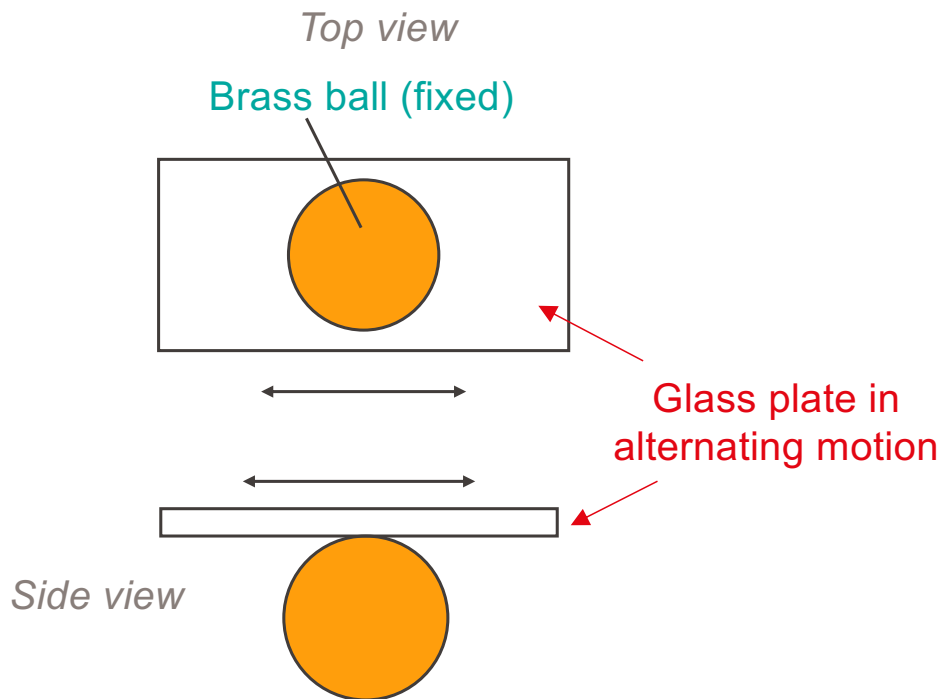
Experimental evidence (III)

- Cross-sectional profile of the wear track of the contact between a steel pin and a cylinder coated with a NiP-SiC composite, after various friction times (1.2 N, 2.2 m/s).



Experimental evidence (IV)

- Microscopic observation of the formation of a third body on a glass/brass contact.



1 Concept

2 Experimental evidence

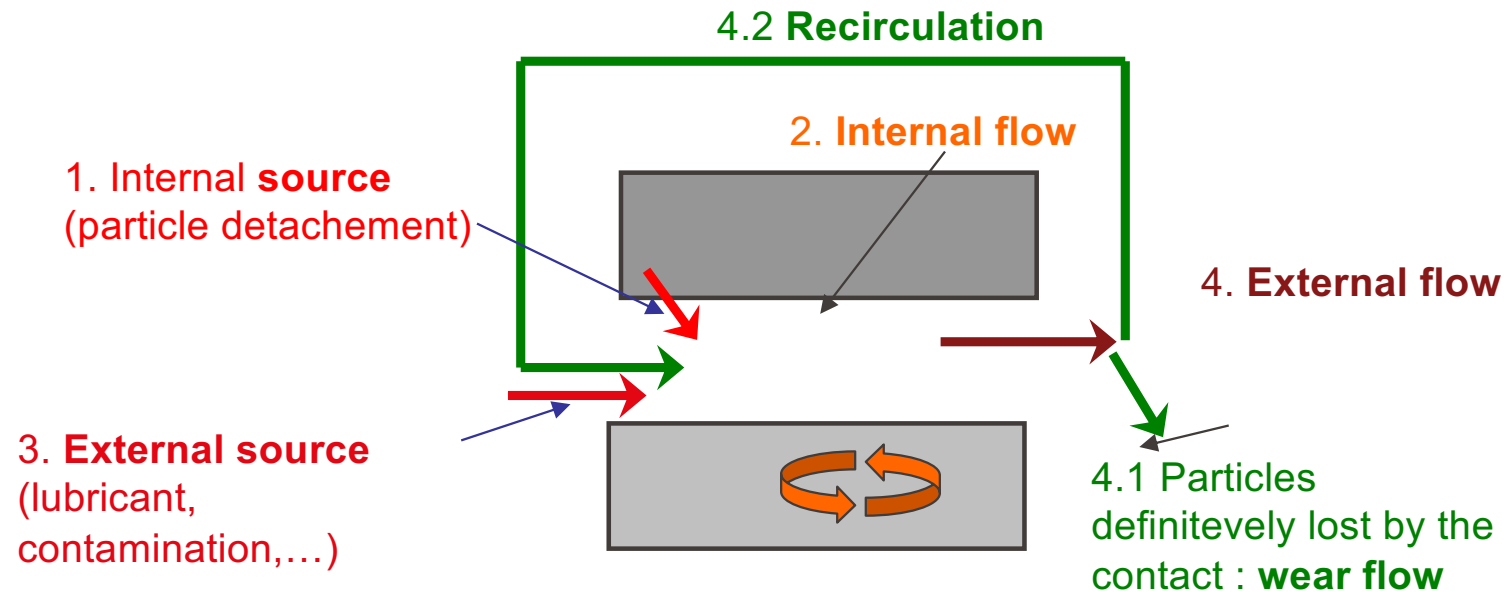
3 Wear as sequence of material flows

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Wear = material flow

- Wear can be described as a flow of particles:



Source flow : **particles detached** from the first bodies through wear
or external introduction of an artificial third body.

Internal flow : **particles circulating** between the first bodies.

External flow : **Ejected** third body particles, splitting into two flows :

- *recirculation flow : reintroduced particles*
- *wear flow : particles definitely ejected from the contact.*

1 Concept

2 Experimental evidence

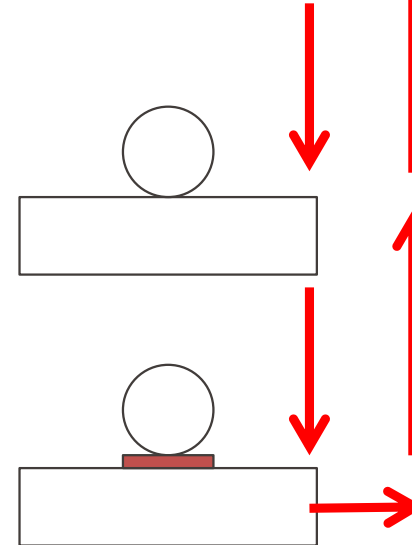
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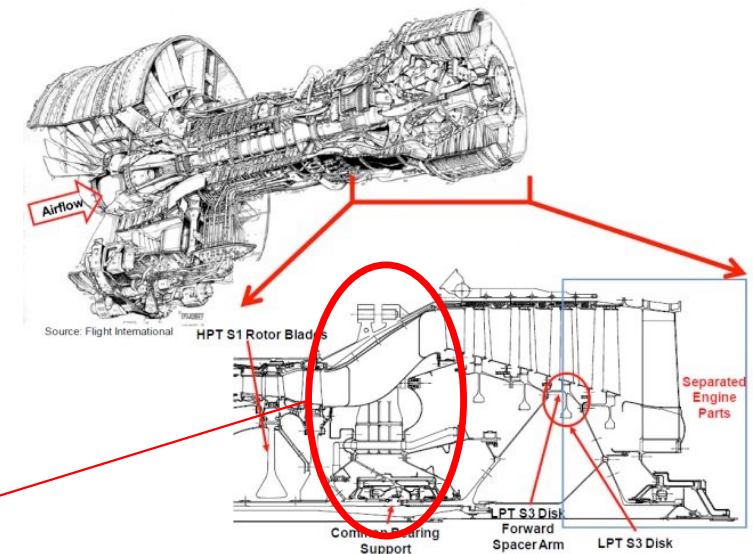
The tribological triplet

- **Mechanism** : combination of elements determining the contact operating conditions and performing a complete functional motion.
- **First bodies** : bulk materials in contact in the tribological system
- **Third bodies** : operator transmitting load from a body to another and accommodating the main part of the velocity difference between the two bodies.



- Stress field
 - Vibration
 - Environment
 - Heat transfer
 - ...
-
- Geometry
 - Contact pressure
 - Motion
 - Contact temperature
 - ...
-
- Material flows
 - Wear
 - Friction
 - Chemical reactions
 - ...

Wear of bearings in 4 engine planes



Wear of bearings mounted in external engines more severe than in internal ones.