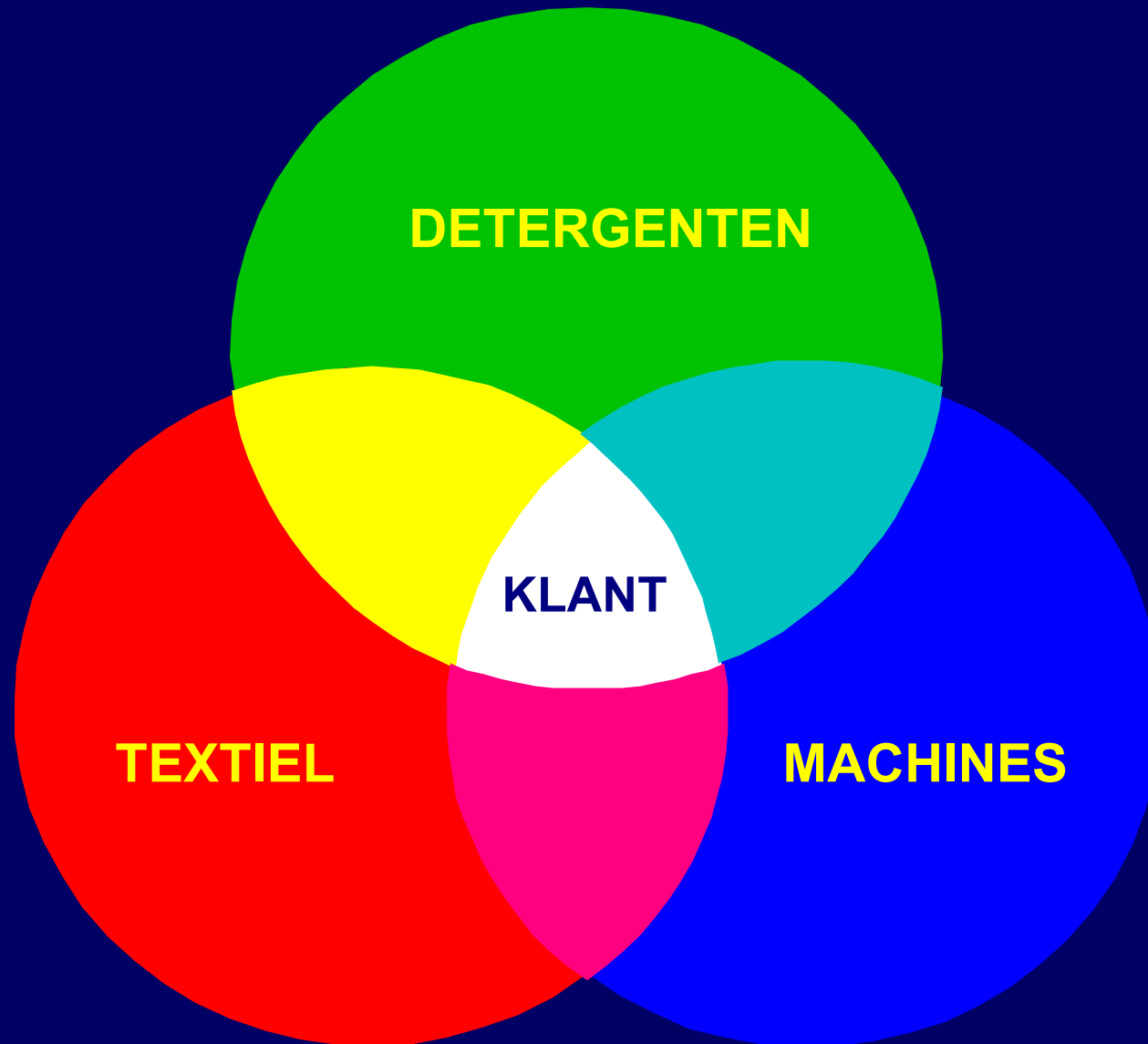


TEXTIEL- EN REINIGINGSTECHNOLOGIE: EEN SCHITTERENDE COMBINATIE



**Marijn Warmoeskerken
Universiteit Twente.**

DE PRIMAIRE KLEUREN VAN HET WASPROCES



WHAT IS WASHING?

- **Washing is the removal of undesired material (soil) from a substrate (fabrics)**
- **Water is used to transport detergents and kinetic energy into the fabrics, and to transport the loosened soil to the wash liquor.**
- **Detergents are used to facilitate the loosening of soil by physico-chemical, chemical and biochemical processes and to prevent redeposition of the soil.**
- **Mechanical energy is used to facilitate the soil loosening and soil transport processes.**



SINNER FACTOREN



Water



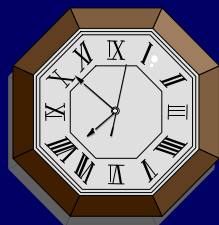
Warmte



Mechanische energie



Chemicaliën

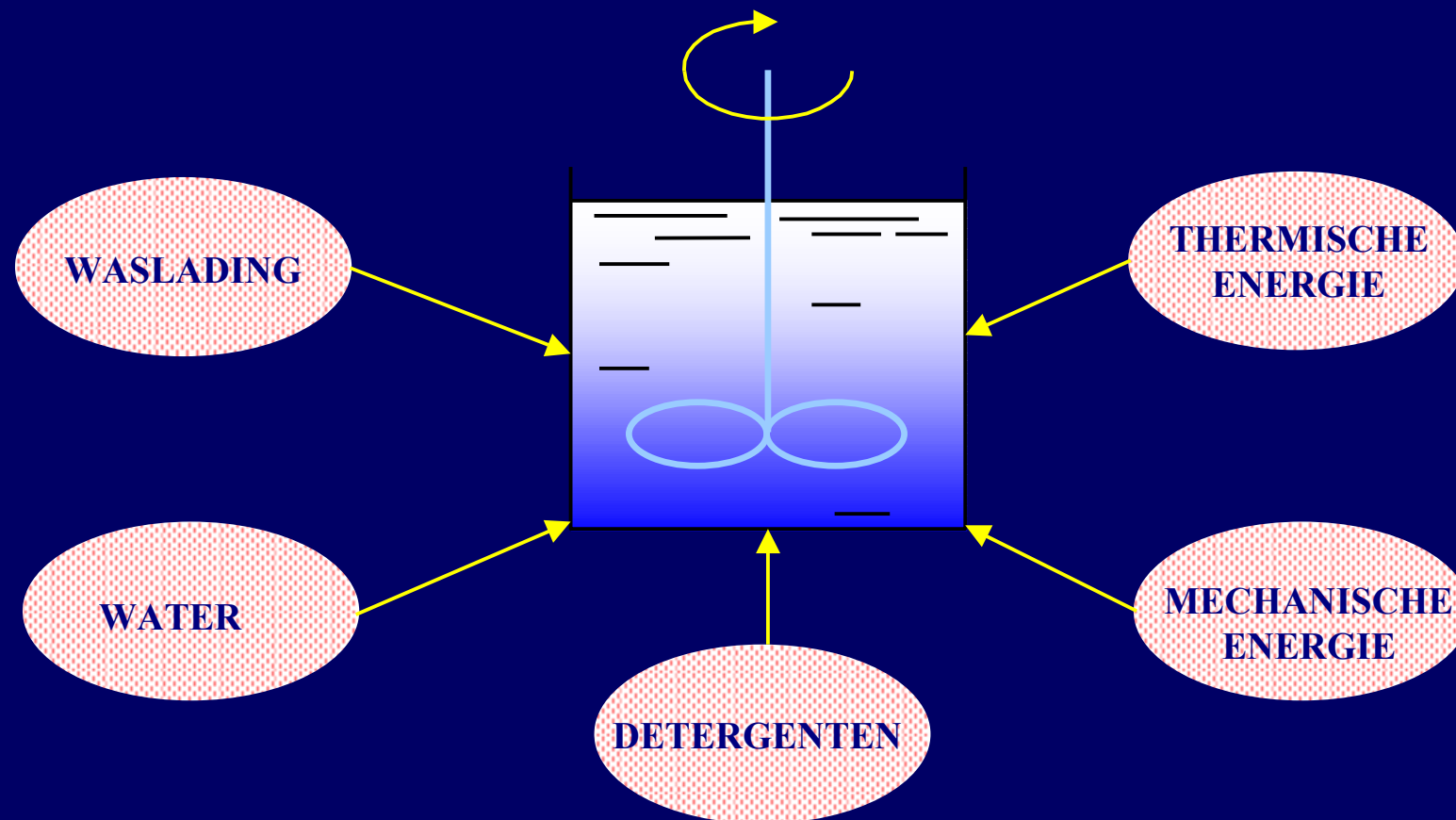


Tijd



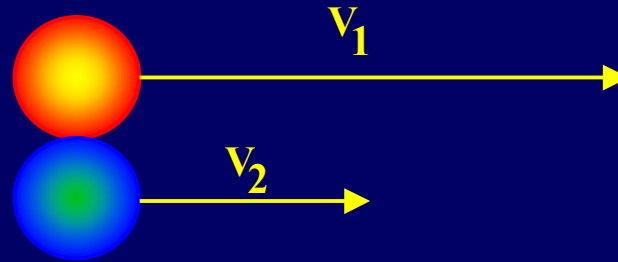
EEN TECHNOLOGISCHE KIJK OP HET WASPROCES

SCHEIDINGS-PROCES VAN EEN PAAR GRAM VUIL VAN EEN PAAR KILO
TEXTIEL



THE PRINCIPLE OF A SEPARATION PROCESS

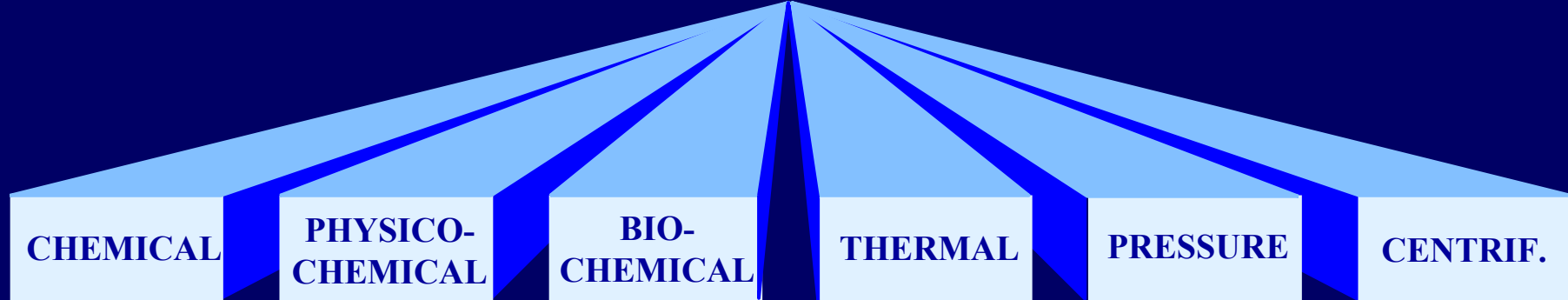
CREATION OF RELATIVE MOTION



MOTION



FORCE

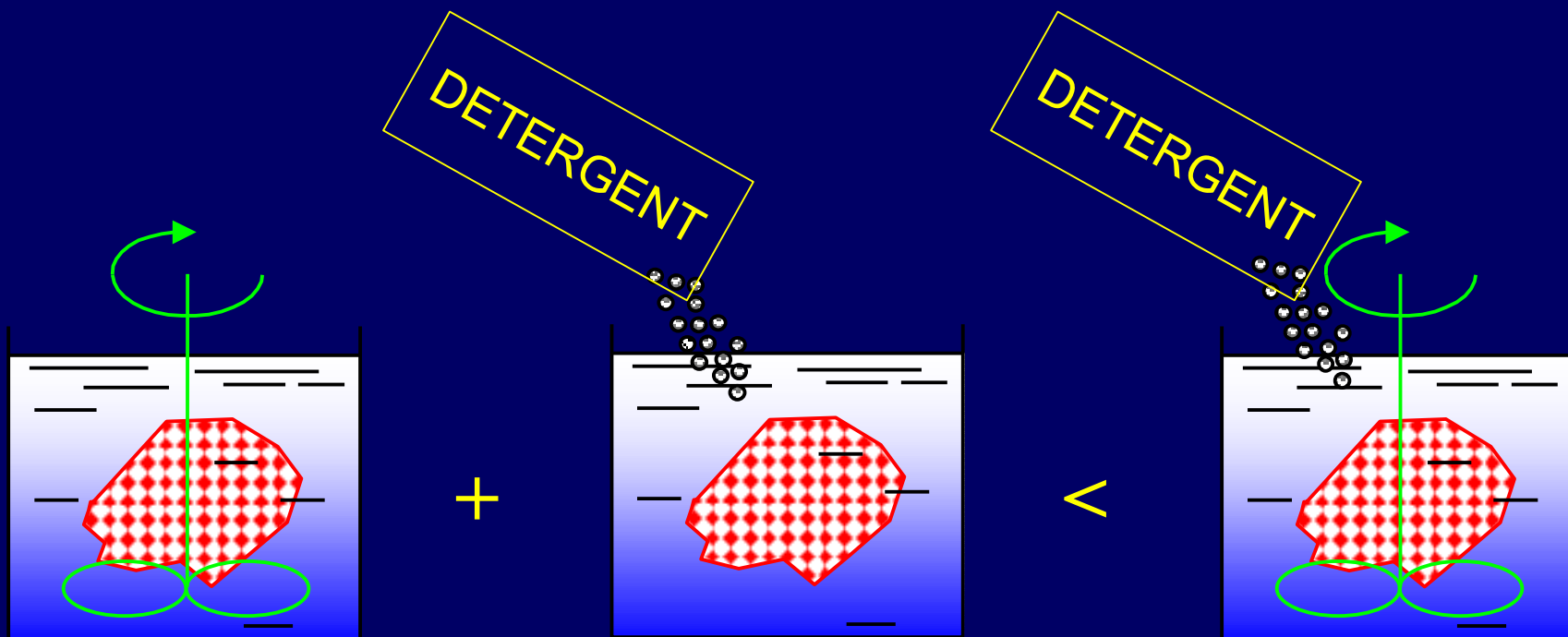


← DETERGENTS →

← MACHINES →



FROM EXPERIENCE



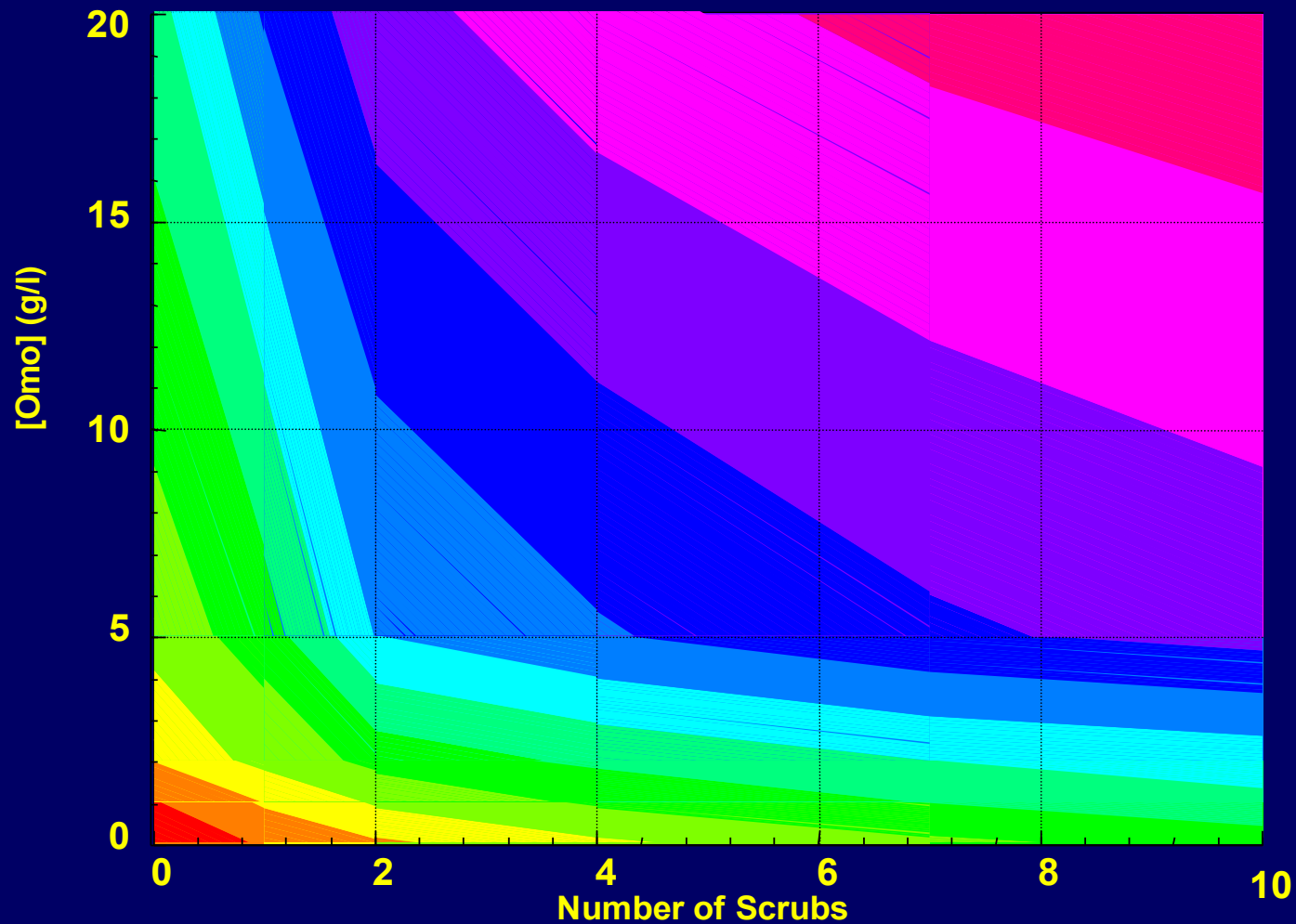
WATER
+
MECHANICAL
ENERGY

WATER
+
DETERGENT

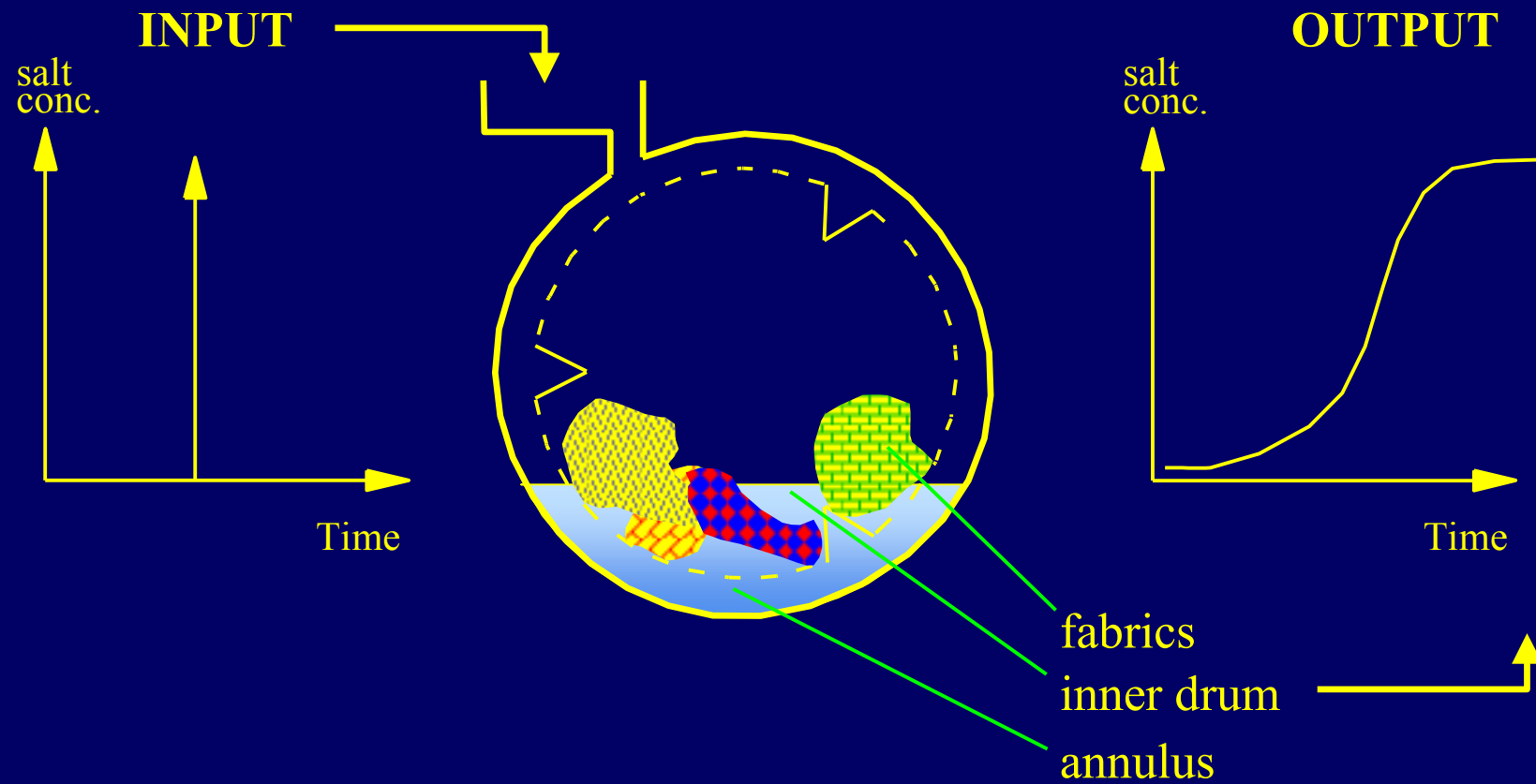
WATER
+
DETERGENT
+
MECHANICAL
ENERGY



The Relationship between Product concentration, physical effort and wash performance on soiled cotton for OMO.



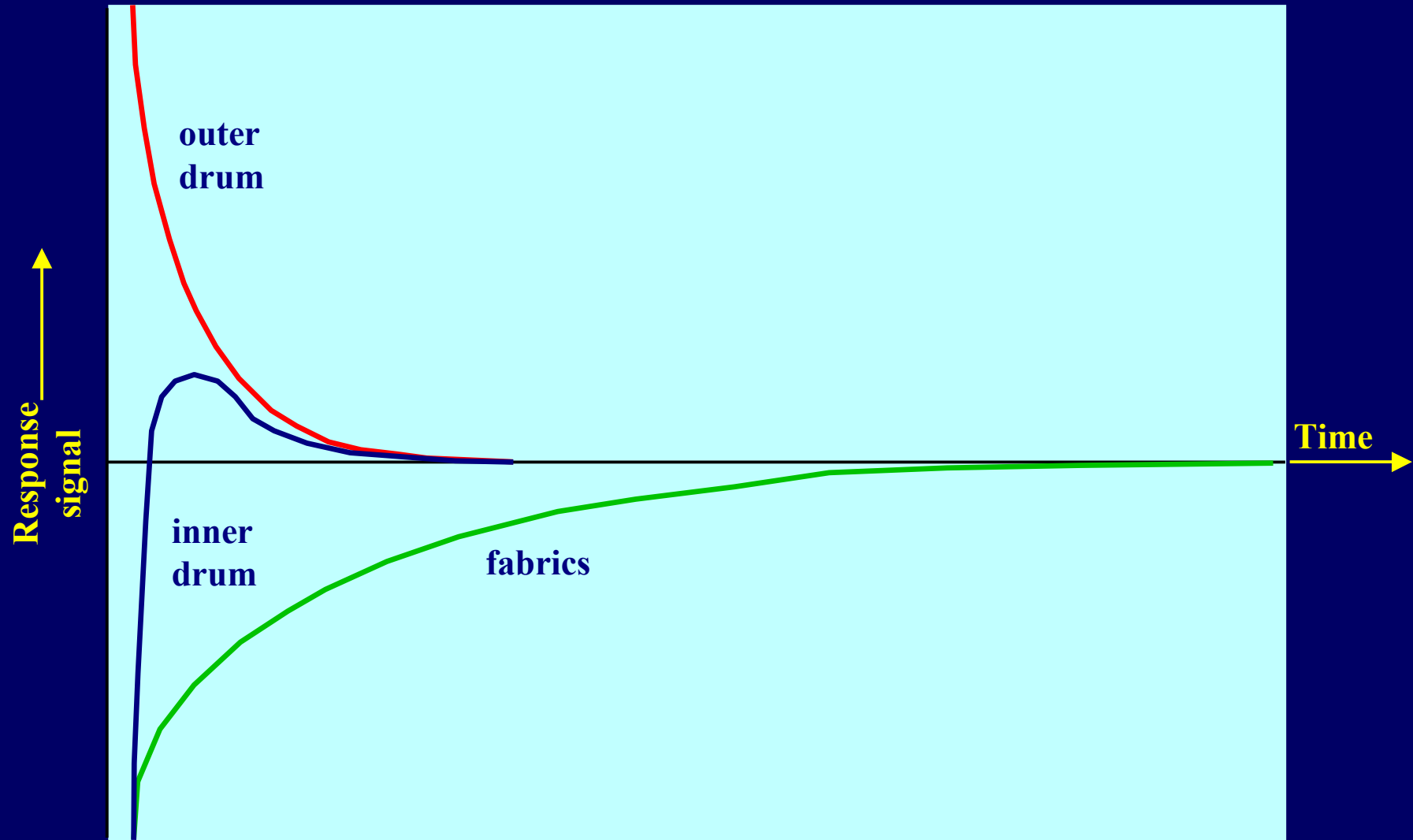
PULSE RESPONSE MEASUREMENTS



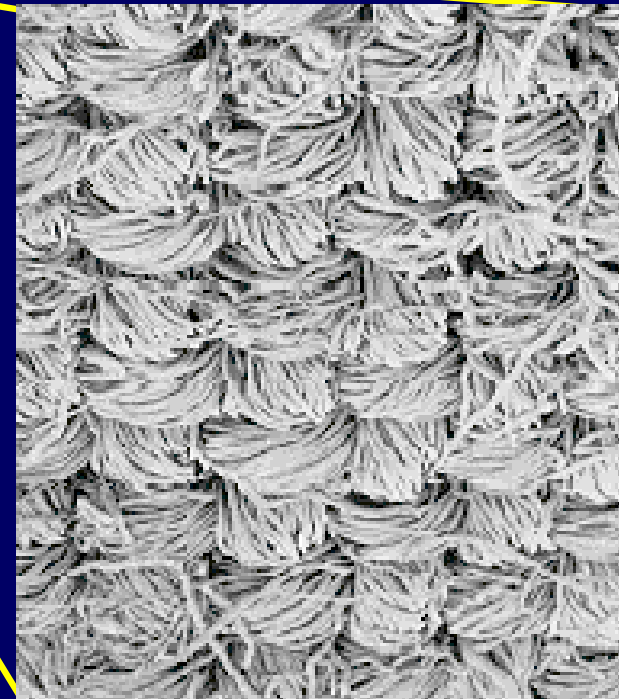
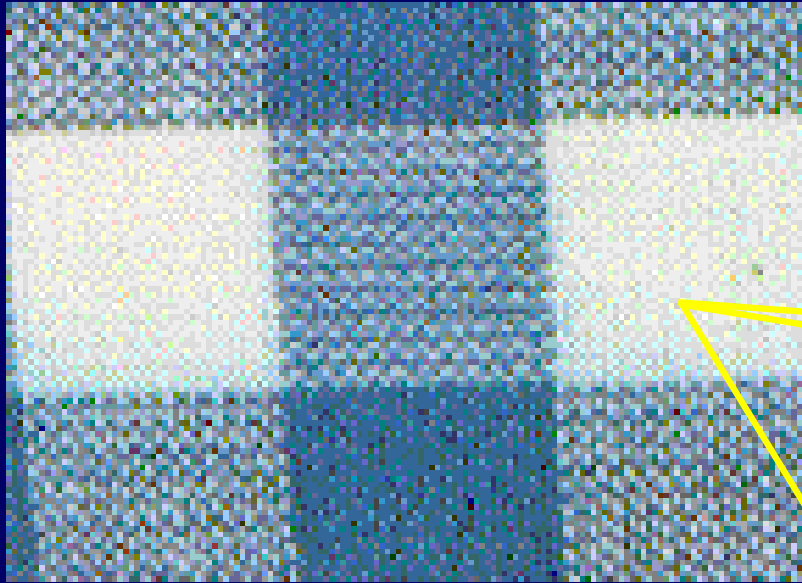
From: L. van den Brekel, PhD-Thesis, TUD, 1987



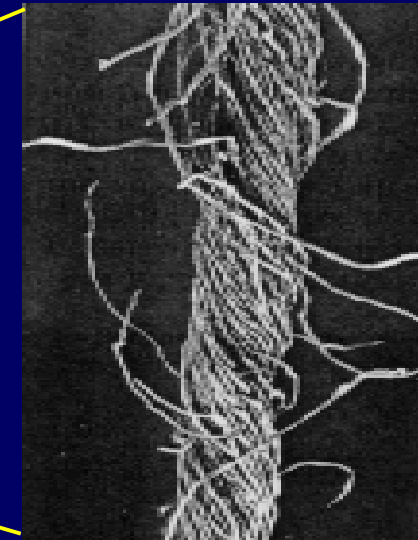
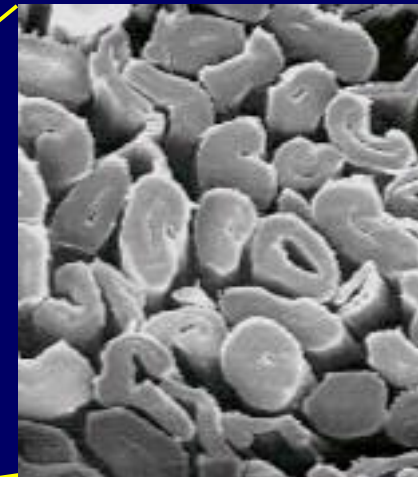
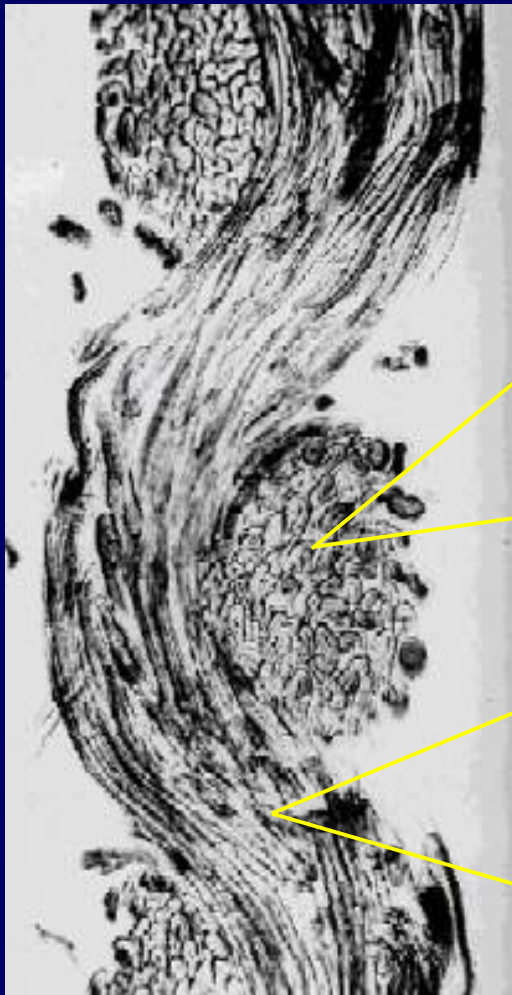
RESPONSE MEASUREMENTS



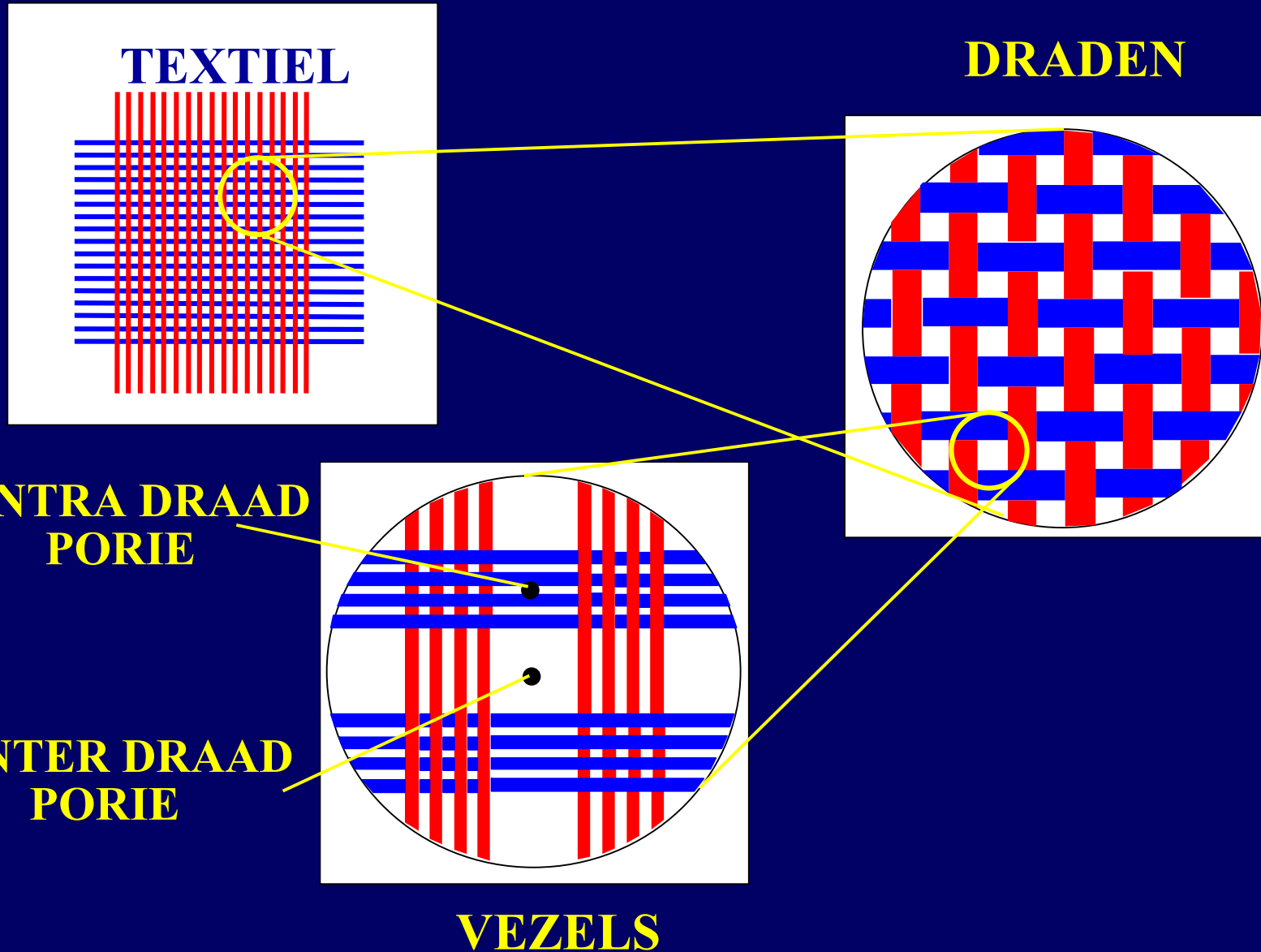
TEXTIEL EN DRADEN



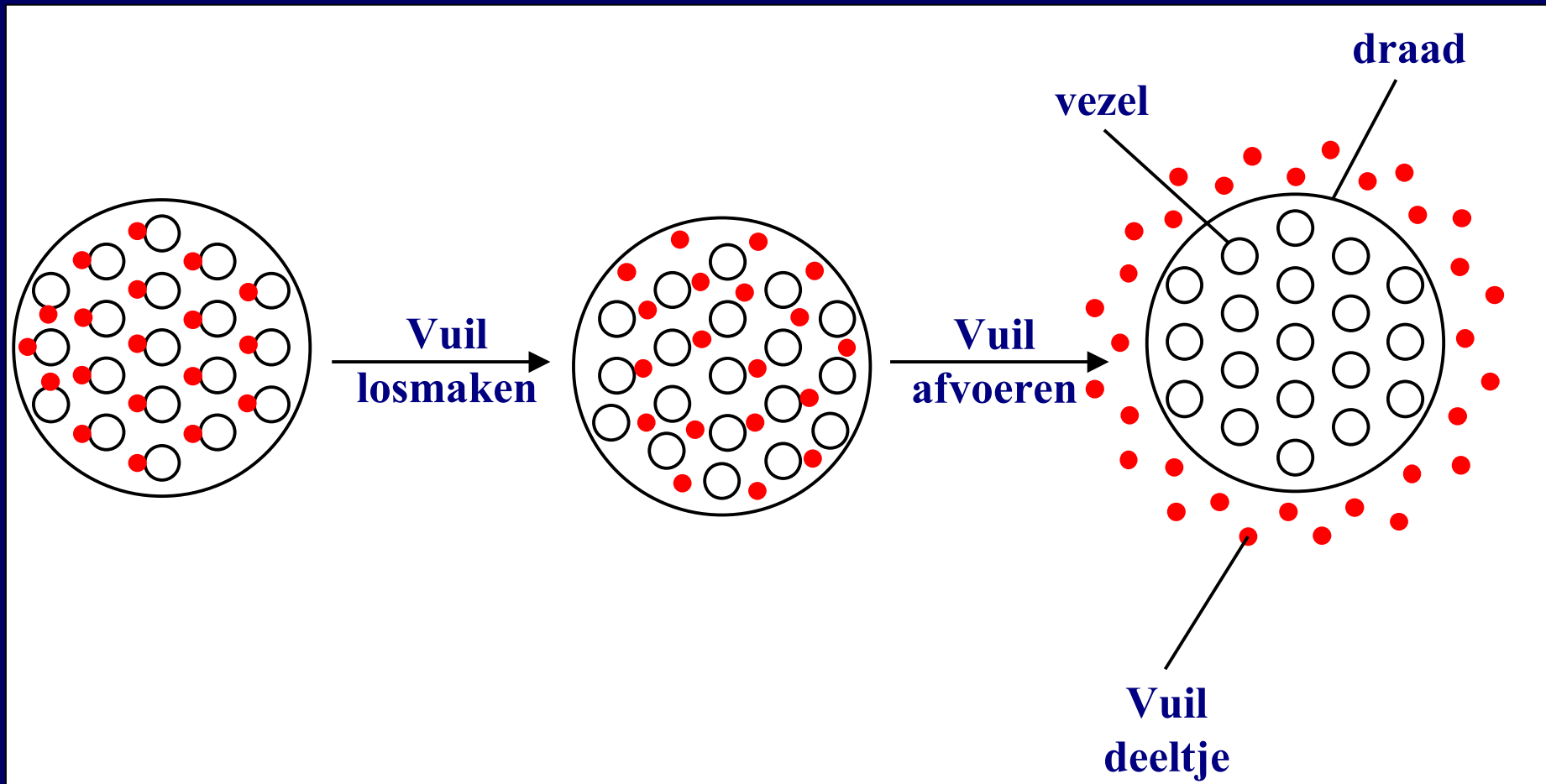
DOORSNEDE VAN EEN DRAAD EN VEZELS



DE BI-POROSITEIT VAN TEXTIEL



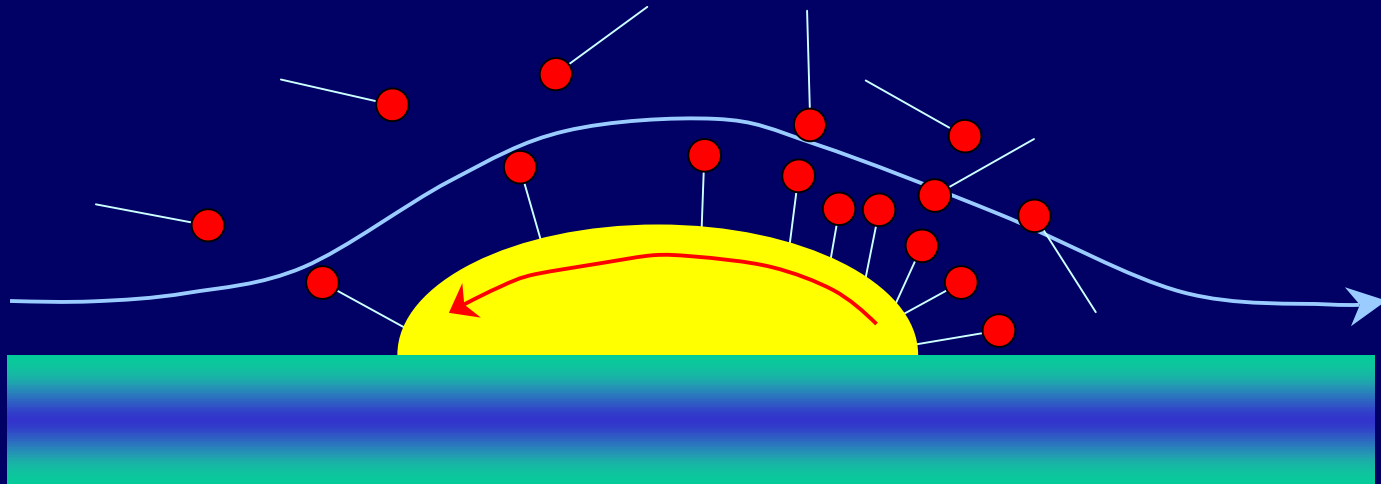
HET WASPROCES ALS EEN TWEE STAPPENPROCES



SOIL LOOSENING

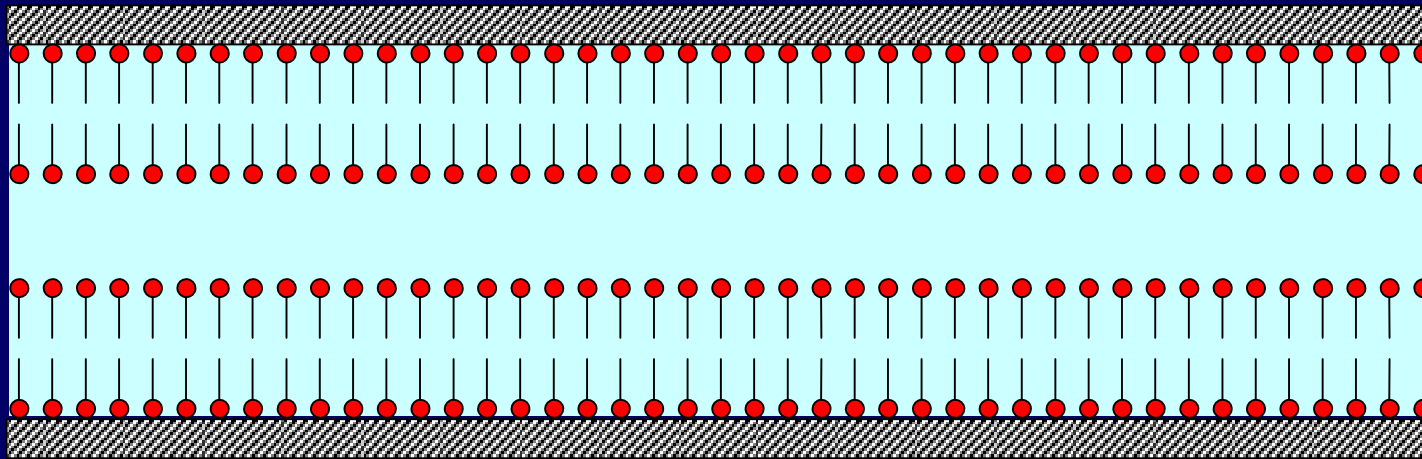
MARANGONI FLOW

Flow due to a gradient in the interfacial tension



SOIL LOOSENING

SLIP FLOW

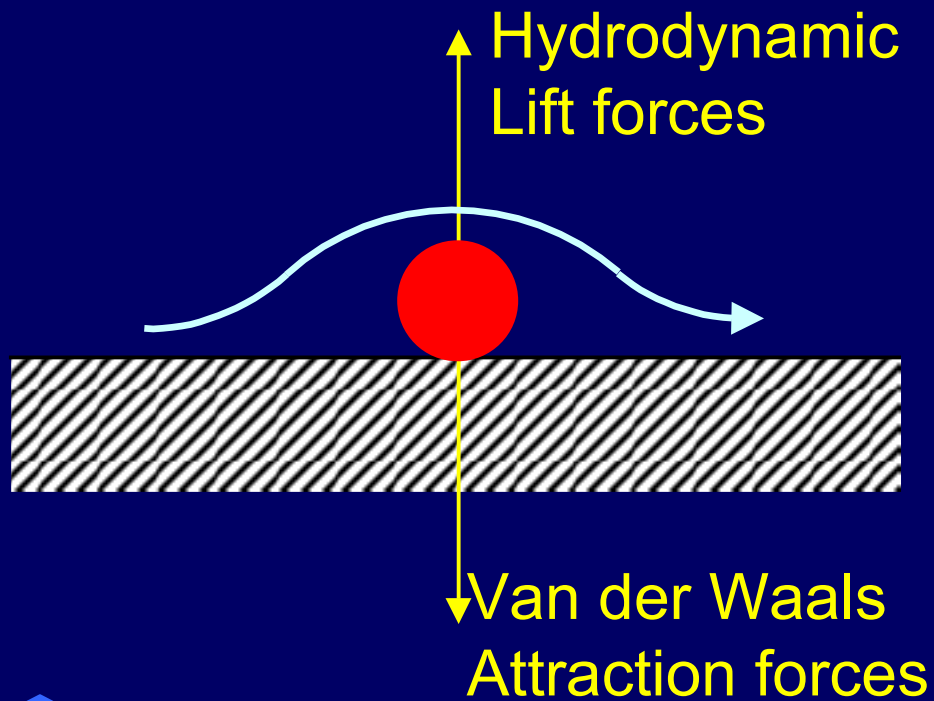


Annemoon Timmerman 2002



SOIL LOOSENING

PARTICULATE SOIL REMOVAL



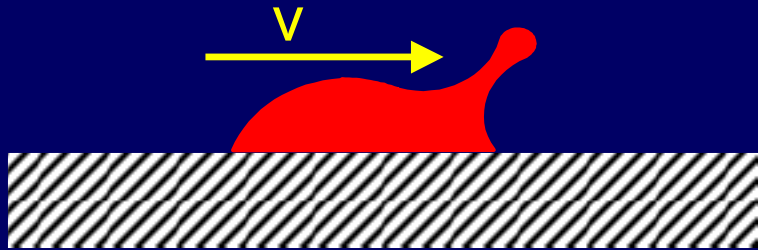
$$F_{\text{lift}} = \frac{\mu v d_p^3}{d_f^2 (2 - \ln \text{Re})}$$

$$F_{\text{VDW}} = \frac{A_{123} d_p}{6 \delta^2}$$

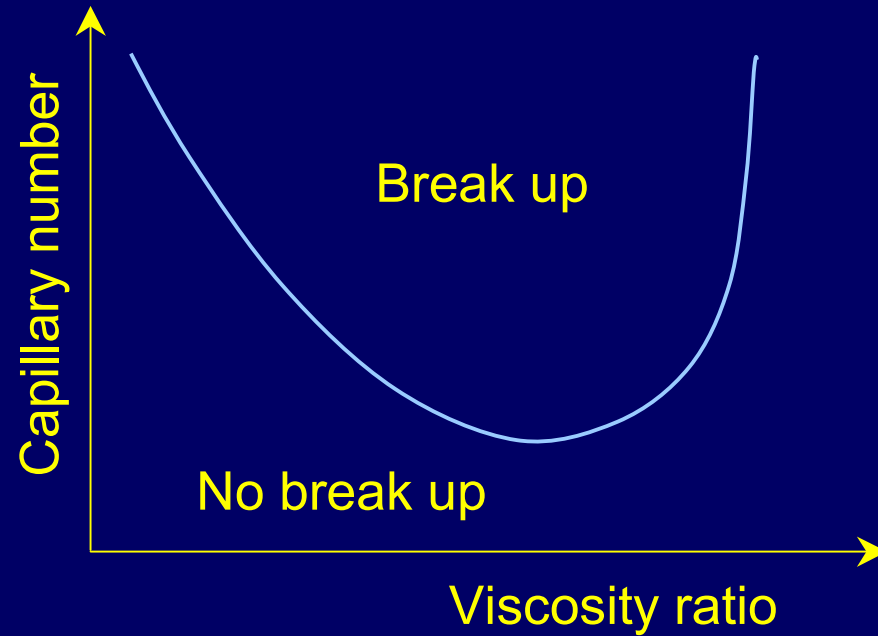


SOIL LOOSENING

BREAK UP OF OIL DROPS



$$Ca = \frac{\rho v^2 d}{\sigma}$$

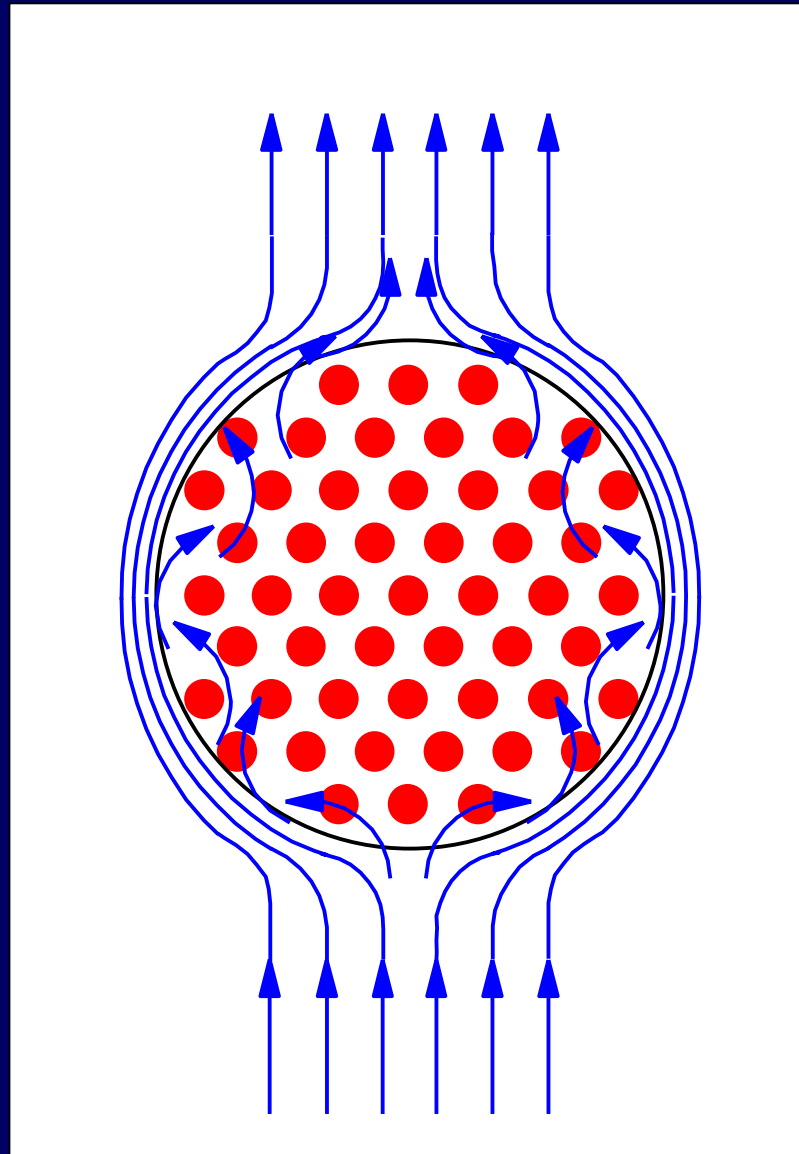


CONCLUSIE

Voor het losmaken van het vuil hebben we detergenten en stroming nodig



STROMING TUSSEN DE VEZELS



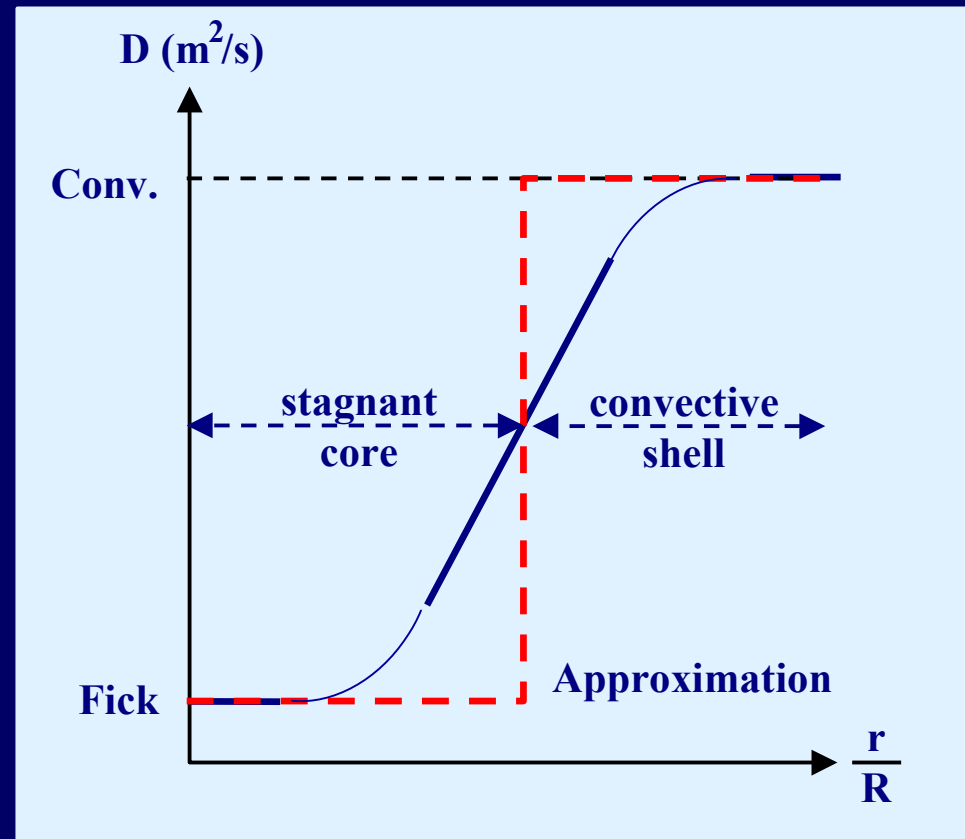
SOIL TRANSPORT

Unsteady soil transfer in the yarn can be described by the equation for convective diffusion in cylinders

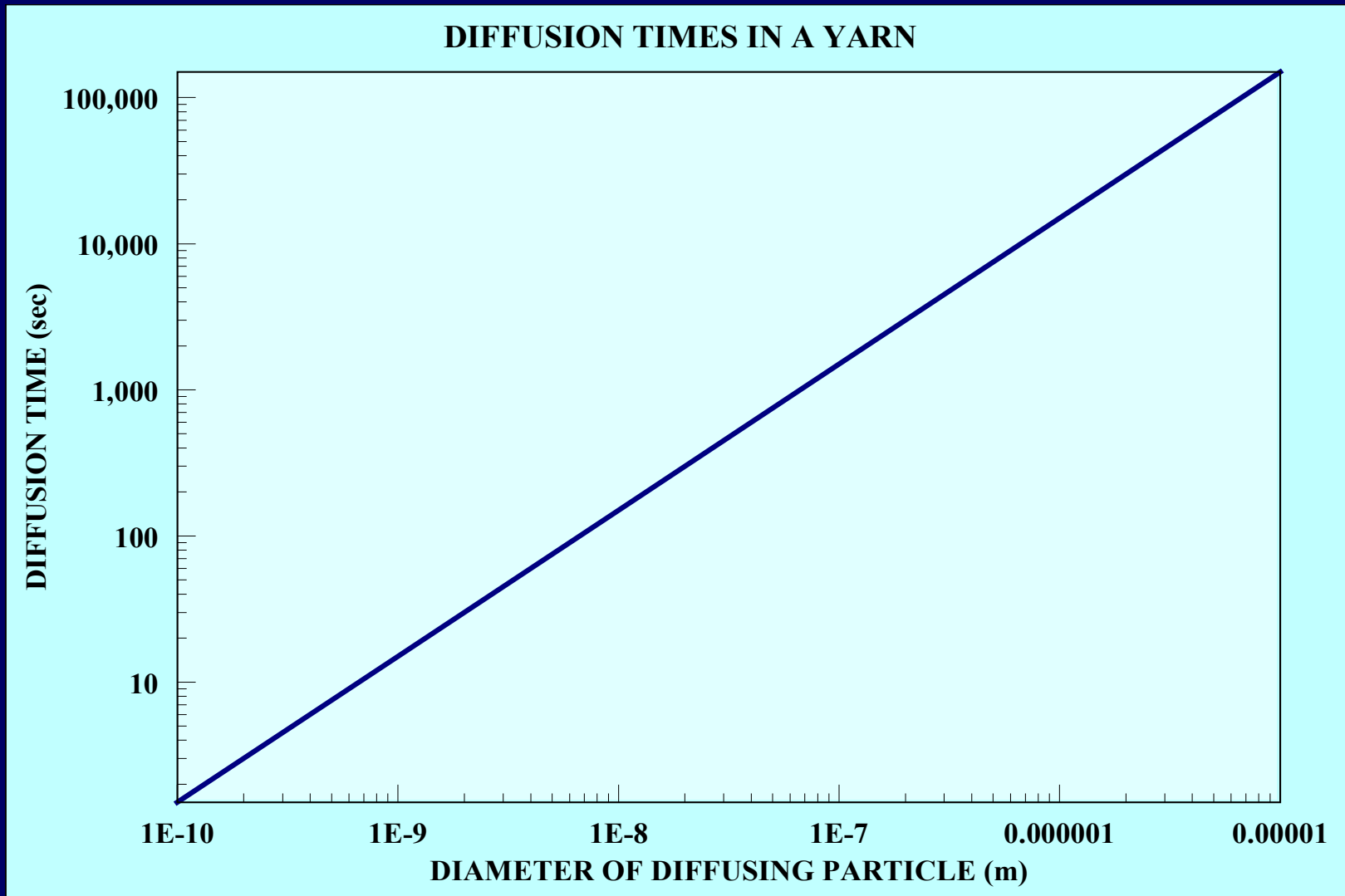
$$\frac{\partial C}{\partial t} = \frac{1}{r} \frac{\partial}{\partial r} \left(r D \frac{\partial C}{\partial r} \right)$$

with:

$$D = D_{\text{Fick}} + D_{\text{Conv}}$$



SOIL TRANSFER



CONCLUSION:

The mechanical action of a machine can be translated into textile deformation, lowering the stagnant core of the yarns and consequently enhancing the exchange rate with the bulk liquid.

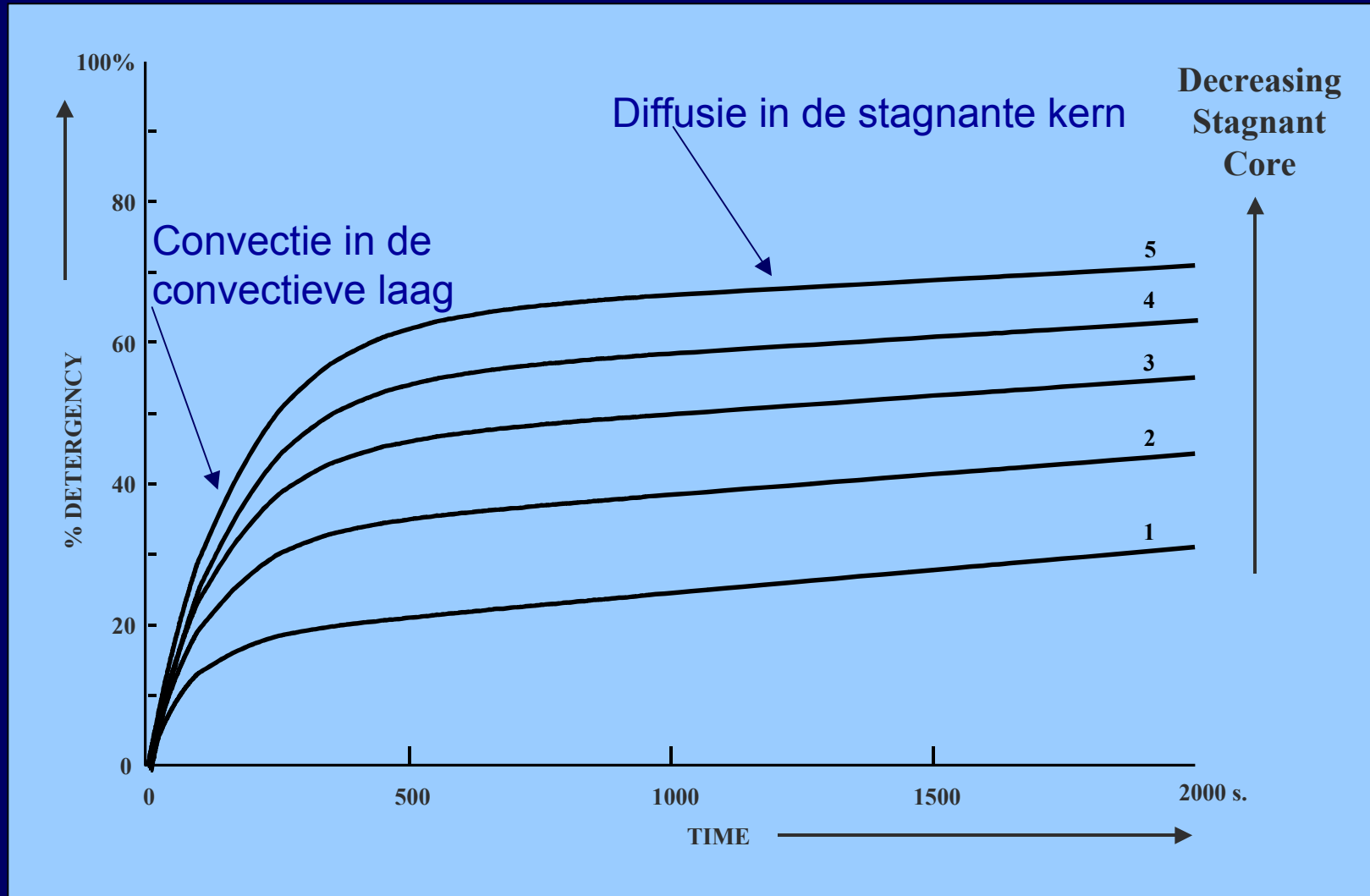
TEXTILE DEFORMATION:

- **PRESSURE**
- **BENDING**
- **STRETCH**
- **TWIST**

FORCE - DEFORMATION - INDUCED INTRA YARN FLOW



DE DYNAMICA VAN EEN WASPROCES

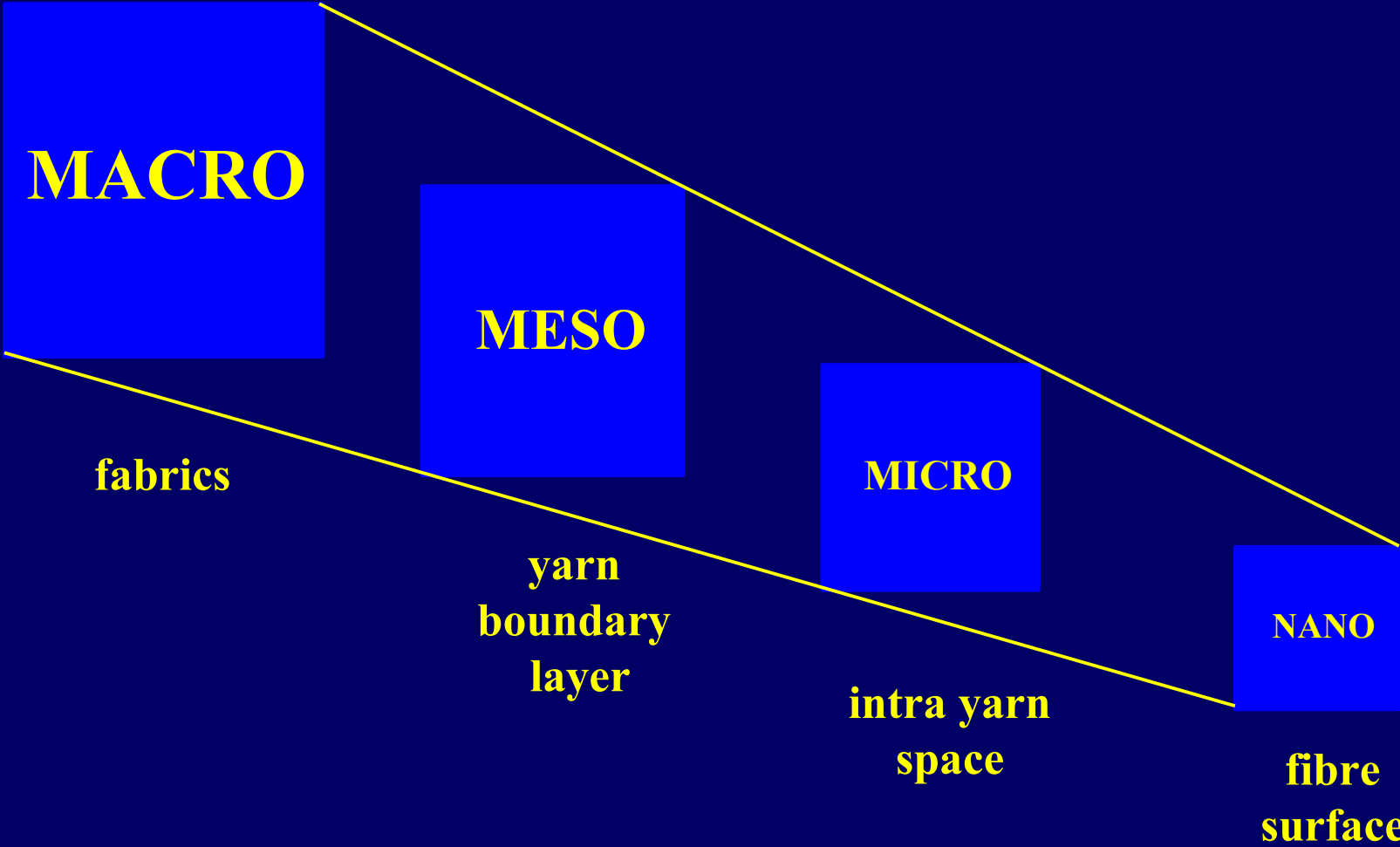


CONCLUSIE

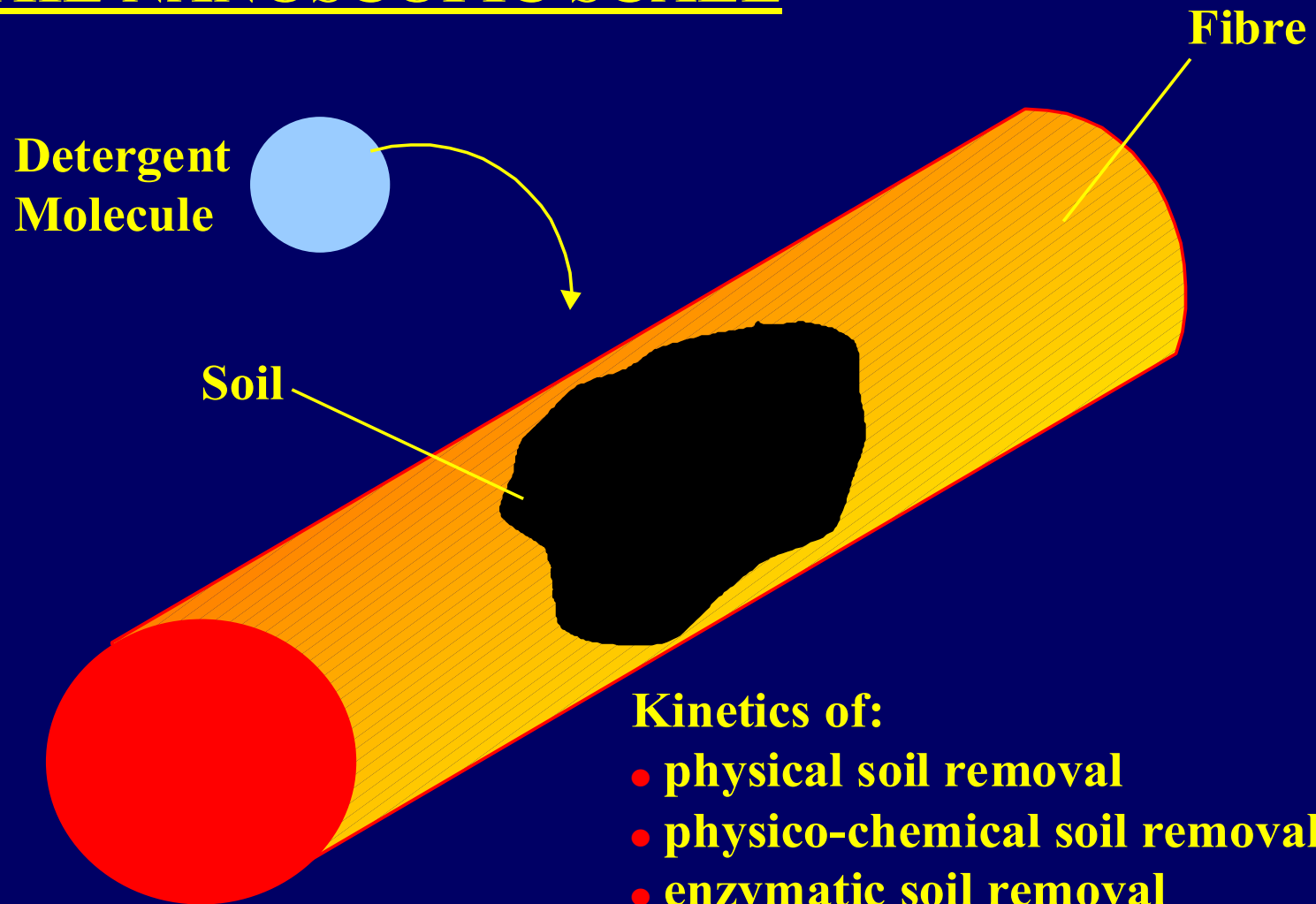
We moeten proberen de stagnante kern zo klein mogelijk te maken.



PROCESS SCALES



THE NANOSCOPIC SCALE



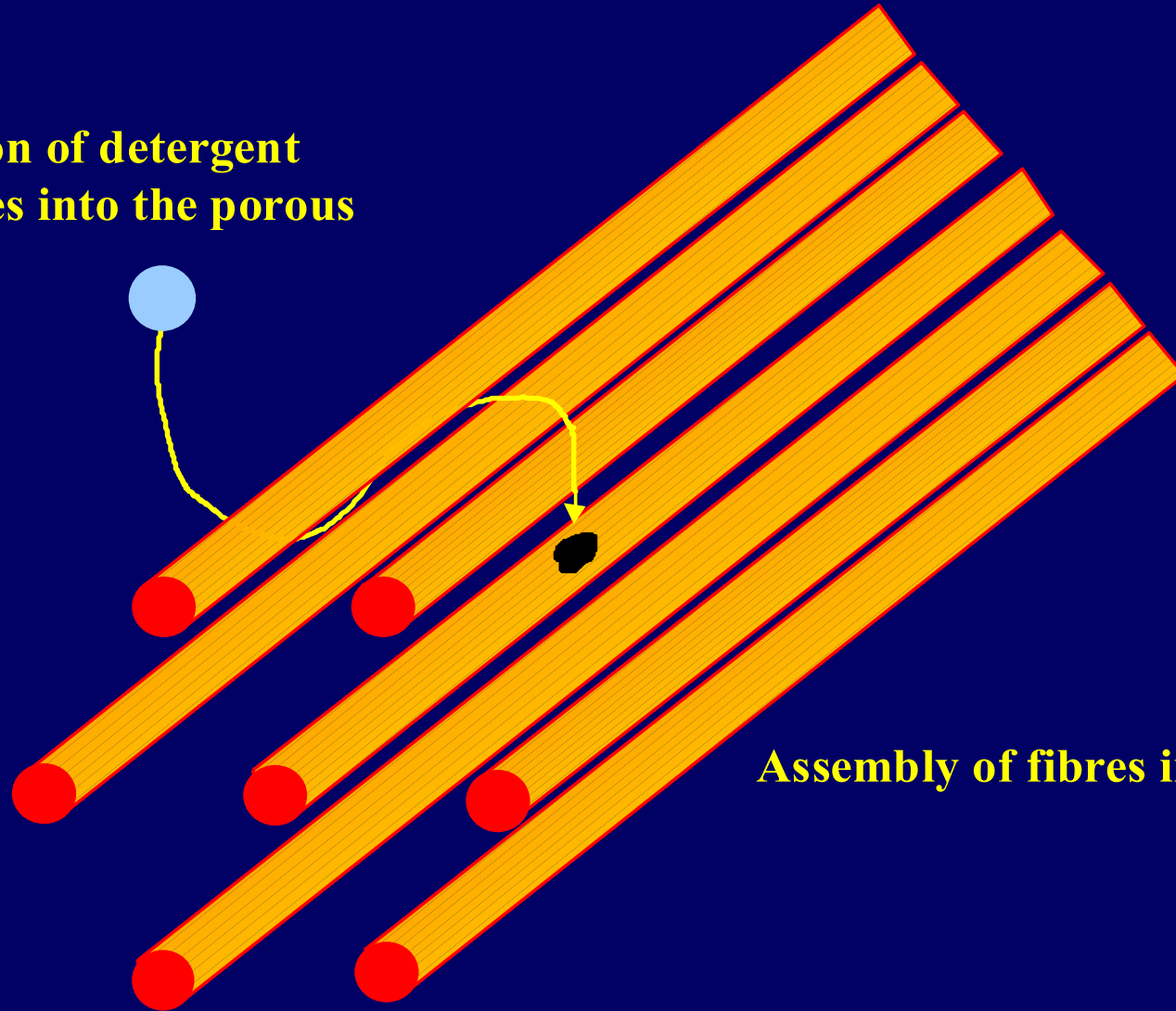
Kinetics of:

- physical soil removal
- physico-chemical soil removal
- enzymatic soil removal
- chemical soil removal



THE MICROSCOPIC SCALE

Migration of detergent molecules into the porous yarn

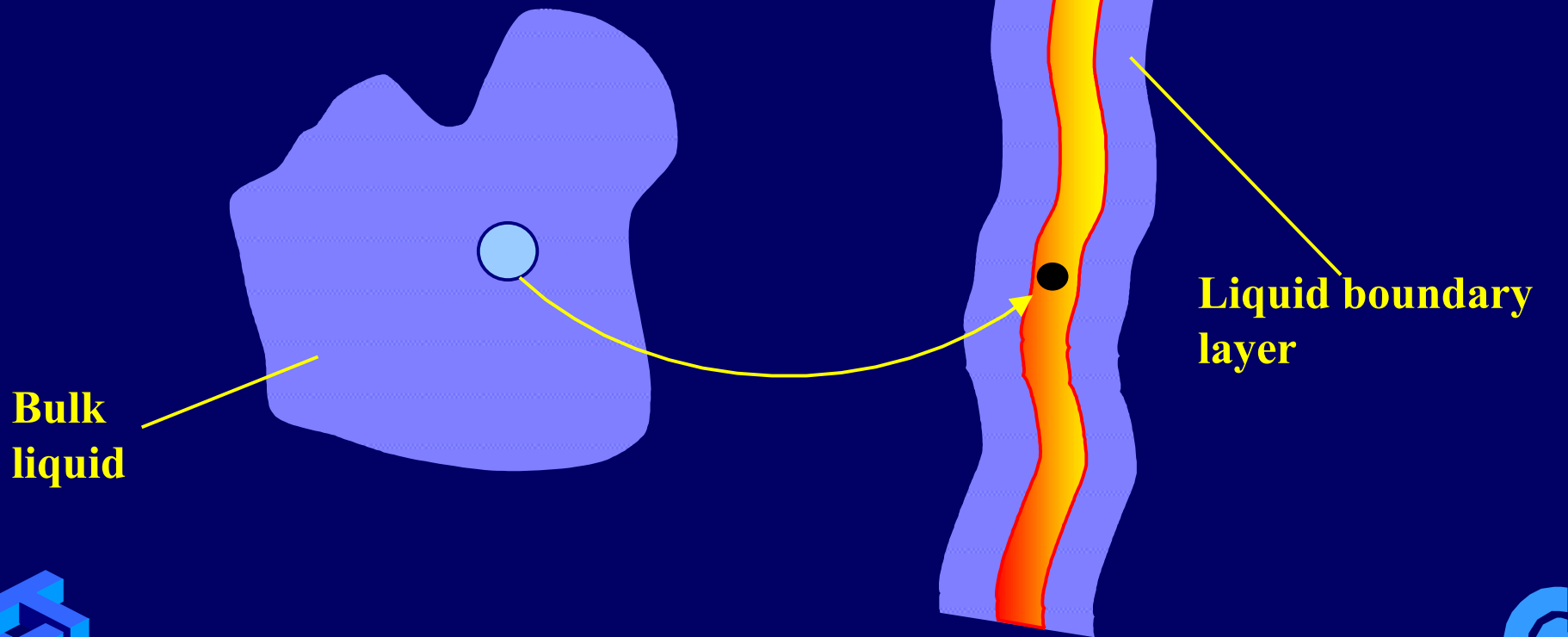


Assembly of fibres in a yarn

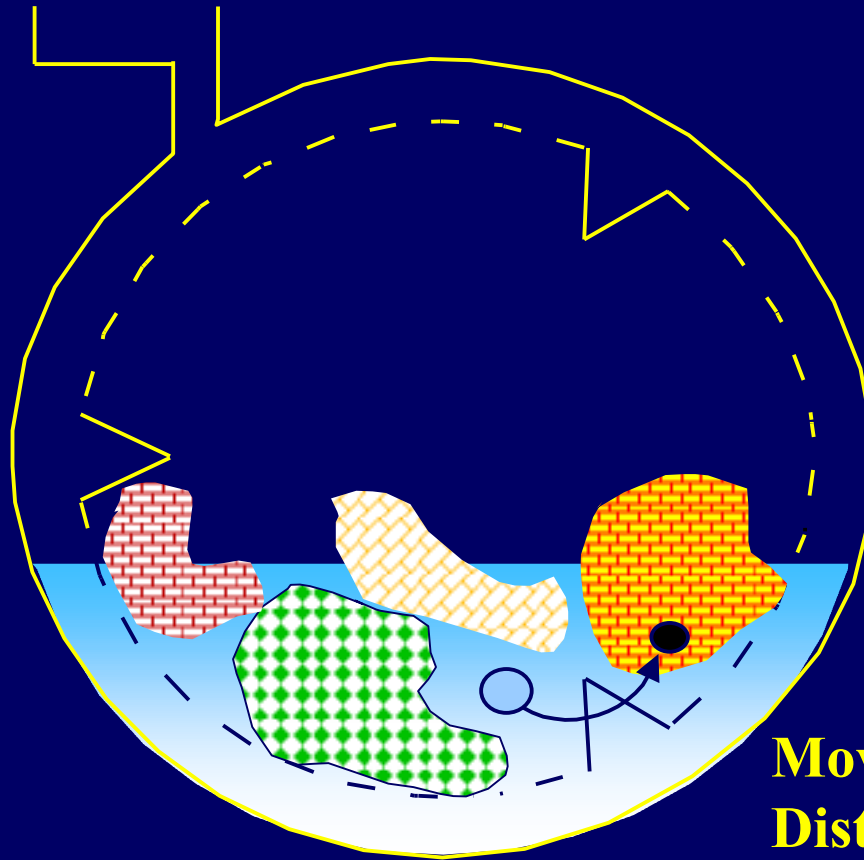


THE MESOSCOPIC SCALE

Transfer of ingredient molecules from bulk liquid to liquid film at textile surface



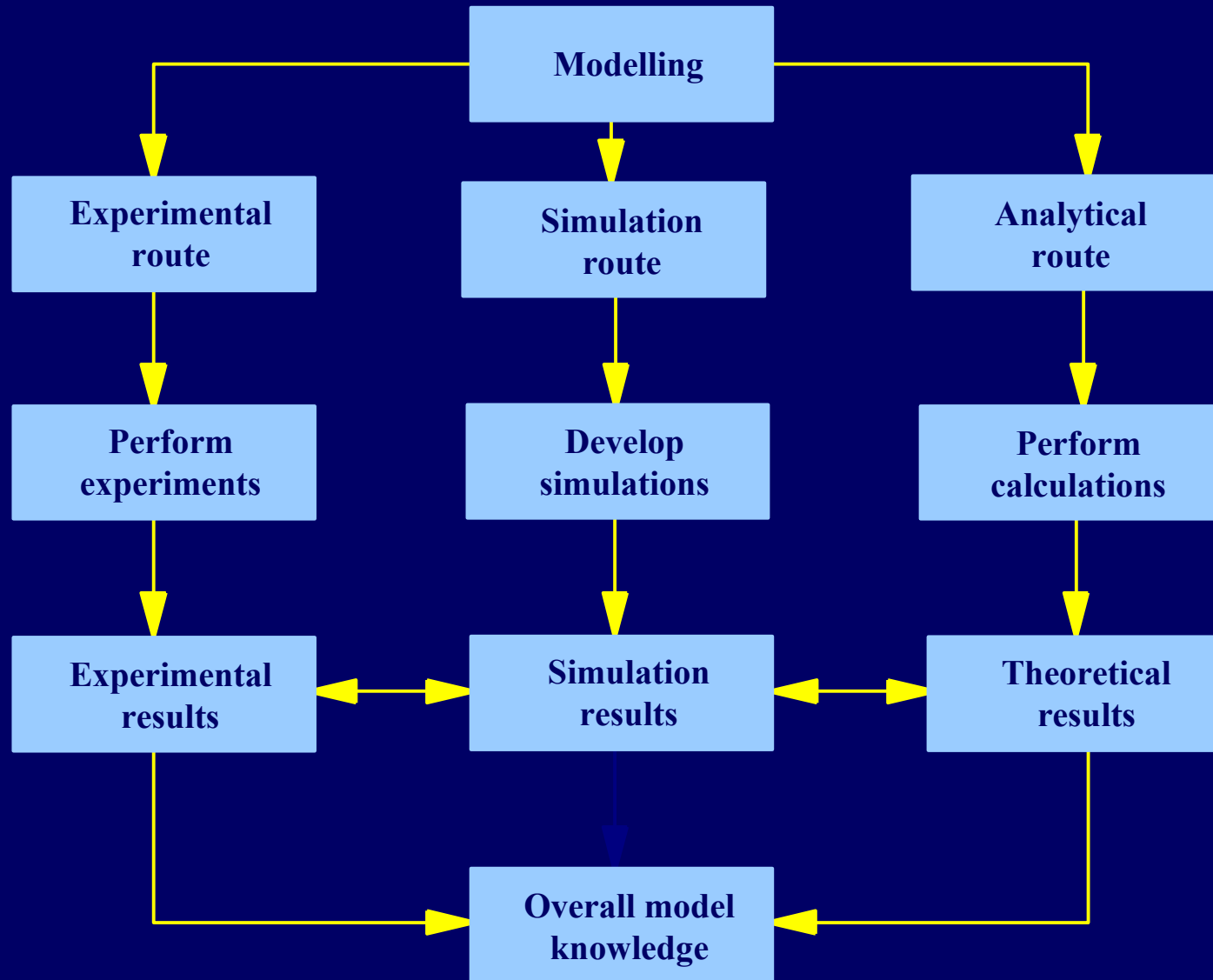
THE MACROSCOPIC SCALE



Movement of the load
Distribution of the powder

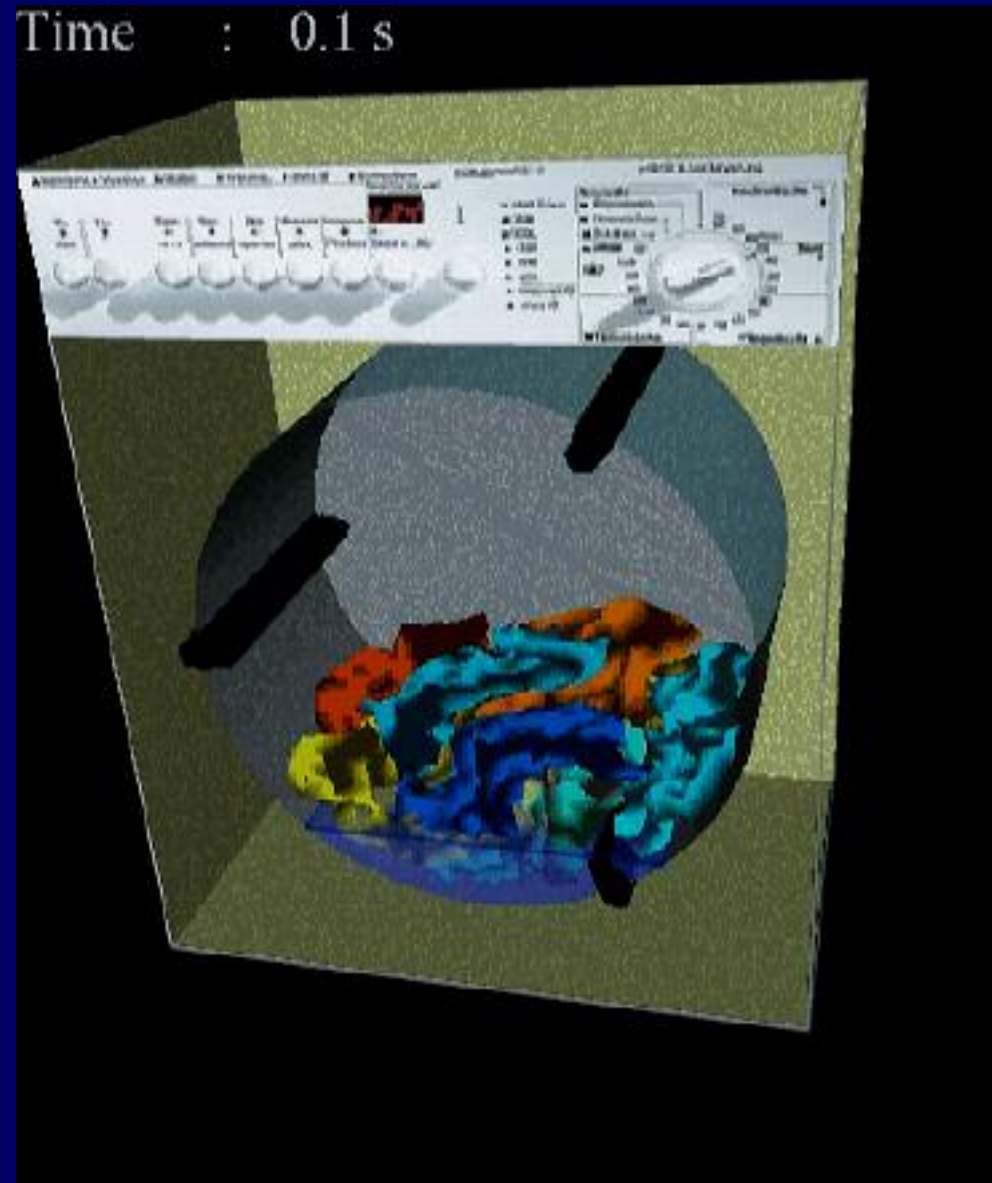


MODELLING STRATEGY



DE BEWEGING VAN EEN WASLADING IN EEN WASMACHINE

Unilever research lab
Vlaardingen.



Deze maand dienen we (TXT-UTwente) een STW projectvoorstel in om deze theorieën en modellen verder te ontwikkelen voor industriële wassystemen.

Daarmee krijgen we in ieder geval een geweldig stuk gereedschap in handen waarmee we straks in staat zullen zijn wasprocessen beter te begrijpen en hun performance te kunnen voorspellen.



LET'S STOP TALKING



LET'S JUST DO IT

