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# DYNAMIC BEHAVIOUR OF THE DOCTOR BLADES USED IN PAPER INDUSTRY

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## ABSTRACT

The dynamical behaviour of doctor blades used in paper industry for cleaning press-rolls is studied numerically and semi-analytically. A multiscale approach combining the dynamic effects of uni-directional roughness of the rolls on the lubrication/cleaning process of the blade is established and a parametric study regarding the geometrical and elastic properties of the blade carried out. The ultimate goal is the theoretical prediction of the cleaning efficiency and the estimated frictional energy loss.

## INTRODUCTION

With a share of 5.7% of the total industrial energy consumption in 2004, the paper industry is one of the largest energy consumer worldwide [1]. In this study, we focus on the tribological behaviour of the doctor blades, alone responsible for the 3% of electricity losses [2]. In this contribution, we extend the steady-state approach in [3] by introducing in the description of the mechanical behaviour of the blades their design and the impact of irregularities of the roll surface on the lubrication mechanism.

## THEORETICAL APROACH

The blade holder is a rigid body constrained to the frame of the machine by a hinge and its position is controlled by a pressurised hose. The doctor blade is taken as a cantilever beam, subject to small linear elastic deformations and fixed to the blade holder by a fixed joint. The blade deformations in the axial and transversal direction are modelled in terms of two coupled spring-mass systems. The lubrication process is described in conventional manner by the Reynolds equation. Let $x$ and $t$ denote the streamwise direction along the roll surface and the time, respectively, suitably normalised. As a key feature of our analysis, then the accordingly rescaled film thickness $h(x,t)$ depends on the movement of the blade tip in contact, expressed by $h_0$, and the resultant waviness of the surface on a macroscopic and microscopic scale, expressed by $r(x,t)$,

$$h(x, t) = h_0(t) + (a-x) \tan \alpha - r(x,t). \quad (1)$$

Here the blade tip is considered as a pad being in contact at a length a, in the current setting inclined by an angle α.

Specifically, a given particle height s defines the cleaning efficiency $C_s$ as the percentage of time where $\min(h) < s$: Fig. 1.

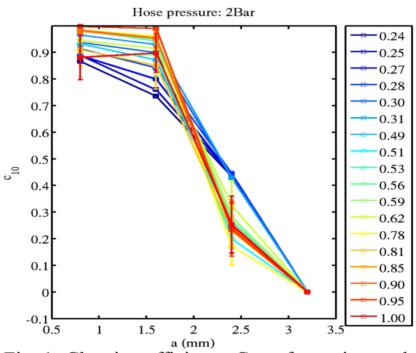


Fig. 1: Cleaning efficiency $C_{10\mu m}$ for various values of the contact lengths *a* and the stiffness, normalised by its maximum value (legend on the right).

## ACKNOWLEDGMENTS

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## REFERENCES

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