# Planar Jet Stripping of Liquid Coatings: Study of Transient Atomization of Liquid Zinc.

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**Abstract**

We present a detailed example of numerical study of film formation in the context of metal coating. In the first stage of the simulation, liquid film is formed on a moving substrate gravitationally. This results in a non-laminar deposit, as the significant density of Zinc rcauses appreciable inertial forces. Subsequently, in a continued computation, we simulate the wiping of this film by planar jet(s) - in actual industrial configuration, two planar nozzles are used. The airflow issuing from the nozzles is strongly turbulent. Depending on the chosen reference scale $L$ - which can be taken e.g. as viscous effects lenghtscale or the domain size - the resulting Reynolds number Re varies between 34 thousands and 9 million, respectively. Air/liquid density ratio is 5300. Surface tension of Zinc is accounted for. Due to this demanding character, number of published works tackling this problem numerically is rather limited.
The simulations have been performed using *Basilisk*, a grid-adapting, modern computational code optimized for execution speed and scalability in parallel runs. Adaptive mesh refinement allows for a high precision in relevant regions such as contact line or liquid-air impact zone, while a coarse grid is applied elsewhere. Besides, *Basilisk* allows for a correct resolution of momentum transfers in this high density-ratio flow, ensuring simulation stability.

Mesh refinement allows the numerical method to cover the wide range of necessary scales from the predicted film thickness (tens of microns) to the domain size (meters). The work presented here included a number of configurations and parameters: we vary e.g. the number of nozzles, domain size and the mean velocity of injected air. At the industrial parameters (injection velocity approx. 200 m/s) we have noticed strong **film atomisation** upon the air-liquid impact. This, to our knowledge, is an effect not reported in literature. We have attempted to verify the physical character of this observed phenomenon by a parameter study, decreasing the Weber number We from 38 to approximately 1 (corresponding to air injection velocity approx 42 m/s). As expected, the resulting airflow was not able to atomize the Zinc deposit, suggesting that observed effects are physical.
The lack of observations of similar atomization phenomena in previously published works may be due to limitations of numerical methodologies used (RANS or LES, lower density ratios). Most of these limitations did not apply here. We are thus convinced that the presented DNS-type calculations consitute an interesting insight to the Zinc-air interaction.

**Keywords:** Liquid atomization, turbulence, applications, numerical simulation

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