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FACOLTÀ DI INGEGNERIA  
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*TESI DI LAUREA*  
ANALISI FLUIDODINAMICA DI REATTORI  
BIFASE GAS-LIQUIDO

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*Project title:*

*“Physical and Computational Modelling  
of Non-Chlorine Cleaning of Aluminium  
in Furnaces as a Tool for Cleaning  
Process Design”*

*Supervisors:* Dr. Waldemar Bujalski

Prof. Alvin W. Nienow

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## Abstract

The furnace treatment is an important step during molten aluminium production, by which the dissolved hydrogen and solid impurity particles were removed. Conventionally, a chlorine/inert gas mixture is used for this purpose. However the potential leakage of chlorine and chemical reaction produce hydrogen chloride considered to be dangerous to society and faces the restriction in the new clean air regulation. So, in order to meet the requirement for the furnace emission and improve efficiency, mechanical agitation through impeller was widely used. In this research, the homogenization behaviour of both lance bubbling and mechanical agitation through two different impellers has been investigated experimentally (power drawn, decolourisation, PIV) and numerically. At equivalent mean specific energy dissipation rates, maximum velocities are higher and mixing times are shorter with the impellers, without to cause surface gas entrainment, the latter being detrimental to fluxing. Two different impellers have been analysed because one is designed to resist at high temperature, STAS, and its material (graphite) does not allow a standard shape, so it was necessary to compare its performance with a standard impeller, 3PBT30. In conclusion, the STAS impeller has been considered a good solution for this kind of cleaning process, in fact, despite the strange shape (very thick blades), the impeller shows nice properties like a standard impeller, 3PBT30. Furthermore very interesting results have been obtained in mixing time using asymmetrical configurations, reducing the mixing time more than 20%.

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