"Citius, Altius, Fortius" – Challenging process design with a proven rationale approach to improve sustainability

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The Olympic motto may seem remote from (bio)chemical processes and manufacturing activities, but one could think of it as an invitation to push science to its limit to get the most out of it. Indeed, when designing new processes or redesigning existing processes, don't we target "*faster*" processes with increased productivities, "*higher*" yields and/or purities, "*stronger*" processes with improved reliability?

A rationale approach to design and develop secured and optimized industrial processes can be based on the synergetic use of experimental data, practical expertise and smart digital tools.

To illustrate this methodology, we will present two industrial case studies featuring very different chemistries: a nitration process and an esterification process. Although inherently highly different by their characteristics, we will show, for these two processes, how a careful analysis and characterization of physical and chemical phenomena, combined with the definition and understanding of production objectives and industrial constraints allows to unveil substantial levers for improvements.

In these two cases, the processes were proven 30-40-year-old processes. As such, gaining 30% of energy and material consumption for one of these processes is already a significant achievement. But showing that, on the other process, the yield can be multiplied by a factor of 4, with no change in chemistries nor reagents, is definitely the highlight of the power of the approach.

Indeed, starting with no preexisting belief on batch or continuous operation superiority but comparing process solutions with a scientific methodology, drastic process enhancements can be reached, thus leading to more competitive and sustainable processes.