

## **AUTOCLAVE OVERPRESSURE: THE HIDDEN VARIABLE**

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### **ABSTRACT**

Autoclave systems have traditionally been plagued by multiple issues, some of which receive more attention than others. The authors' approach to pressure hydrometallurgy problem solving uses first principles to look beyond common practice to mathematics- and physics-based solutions which often run counter to engineering intuition. Perplexing but common autoclave system issues can include autoclave letdown throughput limitations, broken letdown valve trim, excessive letdown circuit erosion, improper sizing, reaction kinetics modelling miscalculations, and harmonic autoclave level control oscillations. These issues all have several things in common: they result in costly and often unnoticed losses; resolution to obvious issues usually happens very slowly; they are significantly interrelated, sometimes at more than one level; and the interrelated sciences are generally not well understood.

Overpressure in the autoclave and its discharge line is related to all these issues, as it affects the root causes of each. Several issues can be simultaneously addressed using the skilled application of multiple interdependent sets of first principle-based equations. A solid understanding of the related sciences and the added benefit of long industry experience help create solutions specific to each site. Autoclave overpressure provides the classic example of the absence of (or indifference to) complex but essential knowledge that leads to solutions and improvement. As a function of total autoclave pressure and discharge fluid temperature, overpressure can be understood as the partial pressure of non-condensable gasses in the autoclave vapour space. Despite its dominant and extensive effects, it is not directly measured and rarely indirectly derived. Without receiving much attention autoclave overpressure has effectively remained a hidden variable for decades.

Accordingly, overpressure fluctuates significantly in most autoclaves. That high variability is detrimental in multiple ways. Consequently, many autoclave sites incur millions of dollars in silent production losses each year. Throughput limitations of this type are often built into production baselines and are thus completely unknown to plant personnel. Strategies for better comprehending and managing autoclave overpressure leading to performance enhancement will also be presented, along with some descriptive mathematics essential to the relevant sciences.

#### *Keywords:*

Autoclave Overpressure, Autoclave Letdown, Throughput Limitation, Autoclave Control, Vapour Pressure