

60 years after Battelle: why to HIP, what to HIP and how to HIP? (Science and Technology behind the Wall of an Autoclave)

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The paper analyzes 40 years of personal experience in developments of PM HIP processes along with the general tendencies of HIP evolution from a process developed in Battelle in 1956 to solve some specific problems in nuclear technology to a world-wide technology of building new materials and structures for critical applications

Fundamental physical and technological differences of HIP from other consolidation and shaping processes are analyzed and the most important applications- outlined.

The major advances in performance of the PM HIPed parts and in PM HIP technology built on the physical principles of thermo-dynamics and heat and mass transfer, are considered through:

- development of large size complex shape components much beyond the limits of casting and forging processes,
- near-net shaping (NNS) capabilities brought by modeling and HIP tooling design;
- enhancement of the properties and performance of large parts through the use of advanced PM alloys and powder compositions;
- radical enhancement of non-destructive inspection of HIPed materials and shapes;
- new cost efficient solutions for powders and integrated or reusable HIP tooling in conjunction with evolving Additive Manufacturing technologies;
- modeling of micro-structural evolution and formation of mechanical properties during HIP consolidation;

Technological, engineering and scientific requirements to the newly developed HIP Equipment and HIP cycles brought by the Near Net Shape PM Technology are developed and formulated

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HIP Process

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