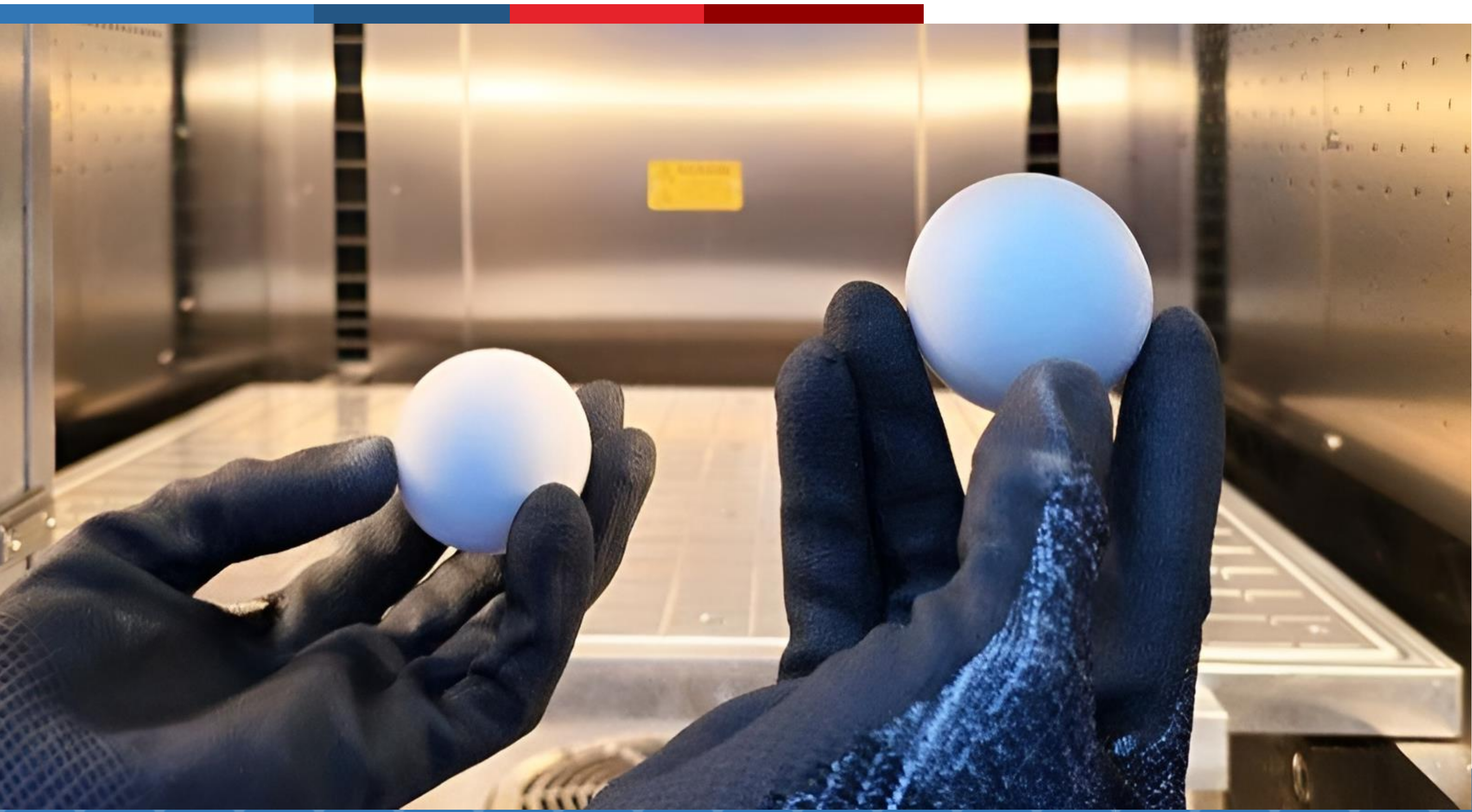
CASE STUDY

RUSSELSMITH

Additively Manufactured Air Release Valve Float for Improved Performance



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Introduction

Water transport systems rely on air release valves to maintain operational conditions, with functionality hinging on the ability to open against internal pressure via an internal lever mechanism. Challenges arise from air pockets in pressurized systems, leading to flow reduction, pressure fluctuations, and other negative effects. Float valve failure, attributed to frequent opening and closing from liquid level fluctuations, underscores the need for a hard and smooth surface finish of the valve float. Additionally, excessive float weight compromises valve efficiency, necessitating higher pressures for closure.

Problem Statement

Installed at sea level, the customer had adopted an air release valve for a water piping system, operating at a pressure of 10 bar (approximately 145 psi) at sea level. Over time, wear and tear affected the valve float, leading to a decline in its functional integrity. The aging of the asset had rendered the valve obsolete, with no original equipment manufacturer's support, making it challenging to obtain a single component without replacing the entire valve system.

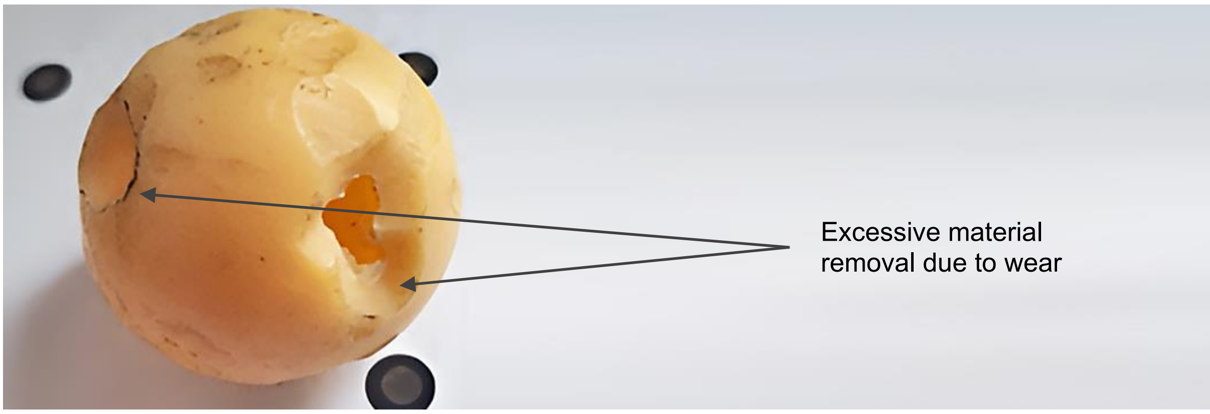

Figure 1: The original Air Release Valve Float that was provided by the Customer

Our Solution – Material Selection, Product Design and Manufacture

In April 2024, the customer approached RusselSmith to address the pressing challenge. Upon receipt of the request and following API Standard 20T, we promptly gathered all the necessary information regarding the operating conditions and conducted a thorough material selection process, considering factors such as the prevailing service conditions experienced by the obsolete float, the anticipated weight range, and the material shrinkage factor.

The replacement float was manufactured with RusselSmith's Roboze Argo 500 industrial 3D printer, using the Fused Filament Fabrication (FFF) technique. A notable observation during the manufacturing process was the tendency of the deposited layers of the material to warp, attributed to the "stair-stepping" phenomenon. This issue is commonly associated with 3D printing of hanging structures and spherical objects.

To address the issue, it was necessary to include supports during production, at the risk of increasing the surface roughness of the component post-support removal, subsequently prolonging the post-processing timeline, and increasing costs. To mitigate these challenges, the size of the designed support structure was reduced by 25%, resulting in the successful additive manufacture of the air release valve float with minimal allowable surface roughness.

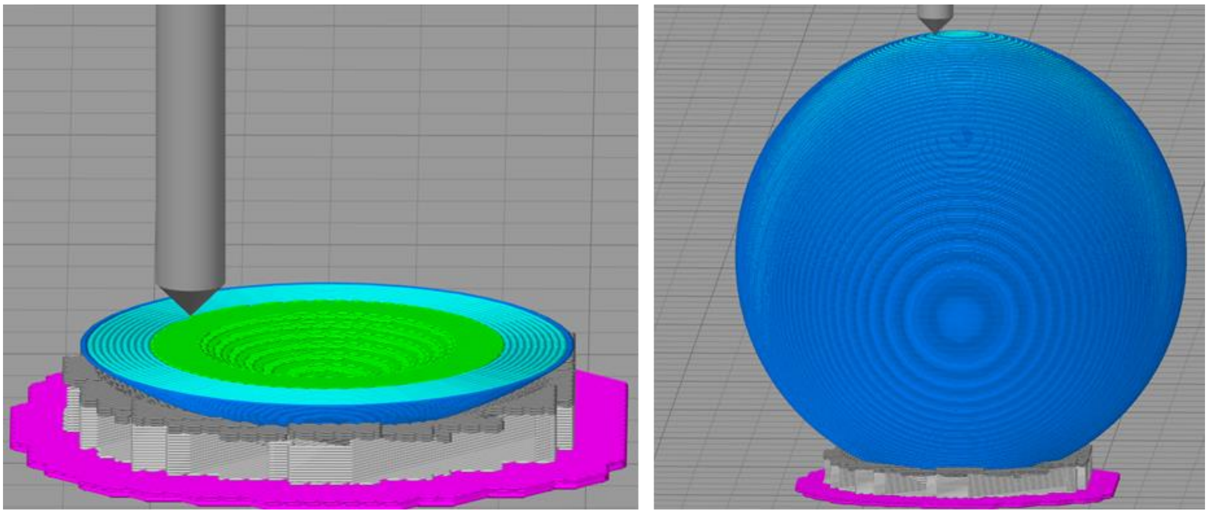

Figure 2: Simulation view of the Air Release Valve Float printing (Left: Build Start; Right: Build Finish)

The Result

Following the additive manufacture of the valve float and successful field trials, the customer provided positive feedback, confirming its adherence to operating conditions. Satisfied with its functionality, the customer proceeded to order two additional units, indicating confidence in the product's reliability. This outcome underscores the effectiveness of the use of additive manufacturing in meeting customer needs for legacy components and reinforces the value of collaborative problem-solving efforts.

Figure 3: Additively Manufactured Air Release Valve Float

Sustainability Impact

The local manufacture of the air release valve float using additive manufacturing technology reduces the carbon footprint of the customer by minimizing the transportation emissions associated with importing such components, and also reduces material waste due to the additive nature of the manufacturing process.

RusselSmith's additive manufacturing solutions promote sustainability through improved material optimization, waste minimization, reduction in emissions associated with shipping of components between countries, and a reduction in overall energy consumption compared to traditional manufacturing methods. This sustainable approach not only enhances the operational efficiency of our customers but also contributes to long-term environmental stewardship and corporate responsibility initiatives.

RusselSmith is committed to supporting the achievement of the global sustainable development goals (SDGs) in the following ways:

SDG #9

Industry, Innovation, and Infrastructure - Additive manufacturing and the development of lightweight, durable components contribute to advancements in industry and infrastructure by promoting innovative manufacturing techniques and improving product efficiency.

SDG #12

Responsible Consumption and Production – RusselSmith's additive manufacturing techniques align with the goal of promoting sustainable consumption and production patterns by reducing waste, minimizing energy consumption, and utilizing resources more efficiently.

SDG #13

Climate Action - By reducing the carbon footprint associated with transportation emissions and minimizing energy consumption, the adoption of additive manufacturing techniques contributes to efforts aimed at mitigating climate change and achieving emission reduction targets.

PROVIDING SUSTAINABLE SOLUTIONS
FOR THE FUTURE OF ENERGY

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