A Monte Carlo light transport simulation is used in scattering-aware color 3D printing pipeline (Elek et al. [2017], Sumin et al. [2019]) to drive an iterative optimization loop. Its purpose is to find a material arrangement that yields the closest match in terms of surface appearance towards a target. As the light transport prediction takes up about 90% of the time it poses a significant bottleneck towards a practical application of this technology. The dense volumetric textures also require a lot of memory. Explicitly simulating every light interaction is particularly challenging in the setting of 3D printouts due to the heterogeneity, high density and high albedo of the media. In this thesis, we explore existing volumetric rendering techniques (Křivánek et al. [2014], Herholz et al. [2019]) and finally engineer a customized estimator for our setting, improving the performance considerably. Additionally, we investigate various storage solutions for the volumetric data and successfully reduce the memory footprint. All the algorithms are available in the form of Mitsuba renderer plugins.