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Cyanoacrylate Infiltration of vacuum adapters built with selective laser sintering (SLS) - a rapid prototyping technology

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Abstract – Rapid prototyping is a general expression that defines a set of technologies to built physical three-dimensional structures, slice-by-slice, from a digital 3D model. A T Shape vacuum connector was built in polyamide utilizing one of these rapid prototyping technologies named Selective Laser Sintering (SLS). Following the connector was infiltrated with cyanocrilate. A vacuum measurement at one end of the adapter exhibited pressure at 10^{-2} mbar.

Rapid Prototyping (RP)[1] is a general expression that defines a set of technologies to built physical three-dimensional structures slice-by-slice from a digital 3D model. Selective Laser Sintering (SLS) is one of the RP technologies that utilizes a laser beam to write the shape of the slices by selective laser sintering process. The slices are built on the top of the previous one until the part has been completed. As a sinterization process the parts built with SLS technology presents intrinsic porosity which limits its applications in low pressure systems. To contour this limitation the porous were sealed with cyanocrylate (Tek Bond, mod. 721) infiltration which is a solvent free adhesive that cures at the presence of air. Moreover it can present low viscosity that allows to penetrate deeply inside the porous walls.

To test the sealing efficiency of the cyanoacrylate on the SLS material – sintered polyamide - a T shape vacuum connector having KF joints on their three ends was built. The sealing process was performed simply by immersing the whole connector in a recipient containing low viscosity cyanocrylate and leaving there until bubbles stopped releasing (about 7 minutes). Following the connector was left exposed to the air for 24 hours to cure the cyanocrylate. Few days afterwards it was connected to vacuum system evacuated by a rotary pump.

The follows results were achieved: (1) the cyanoacrylate did not attack the polyamide, (2) the adapter did not collapse under evacuation process; (2) the flanges of the KF joints were not damaged by fastening the C clamp; (3) the pressure sensor connected to one of the KF joints indicated the same pressure of the sensor connected next to the pump, meaning that the better performance had been obtained with the sealing process and experimental set up. The adapter however did not keep the low pressure when isolated from the pump indicating that some degassing process was operating.

The results obtained so far show that the polyamide adapter built com SLS having the porous sealed with cyanocrylate infiltration could be used in a vacuum system at least at pressures around 10^{-2} mbar. We envision that complexes vacuum chambers, made of polymer, built according to the procedures here described, can be used to perform low vacuum experiments in a rapid manner and at low cost.

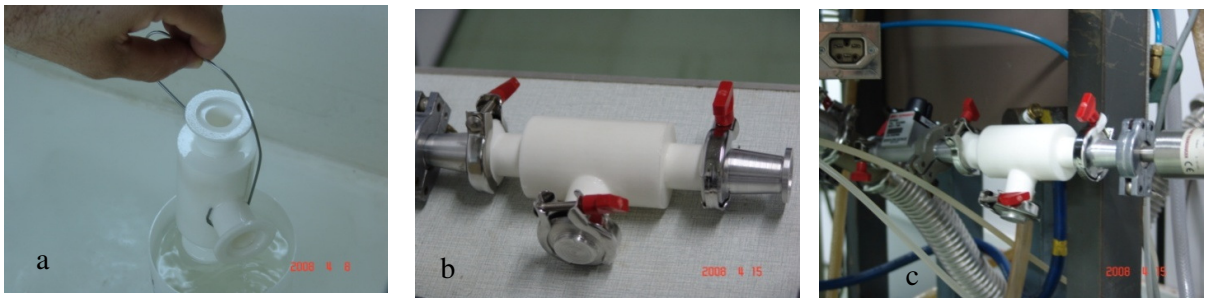

Figure 1: (a) – The polyamide T shape adapter is : (a) removed from the cyanoacrylate bath. (b) assembled with KF joints and (c) inserted in the vacuum system

1. N. Volpato, Ed.; *Prototipagem Rápida Tecnologias e Aplicações*; Blücher, São Paulo, 2007, 1-239.