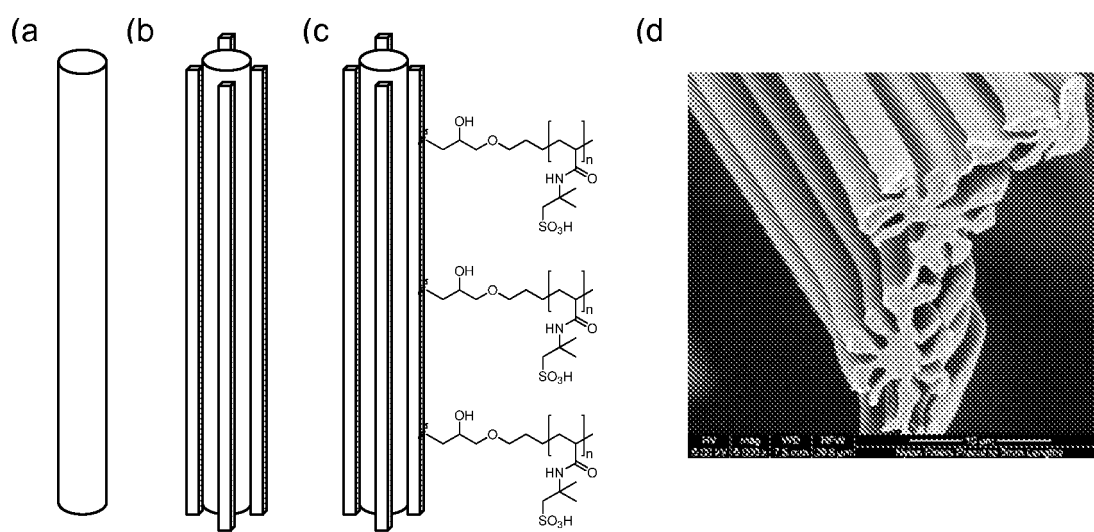
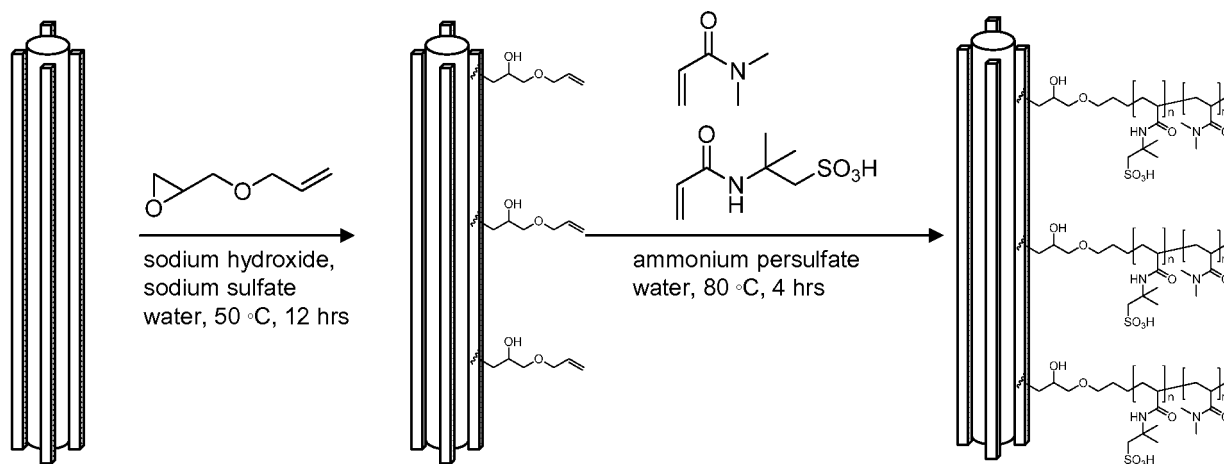


FIG. 1a-1d

1(a)-c): A schematic illustration of fibers of the inventive concept. 1(d): SEM image of Allasso Industries Corporation winged fibers.

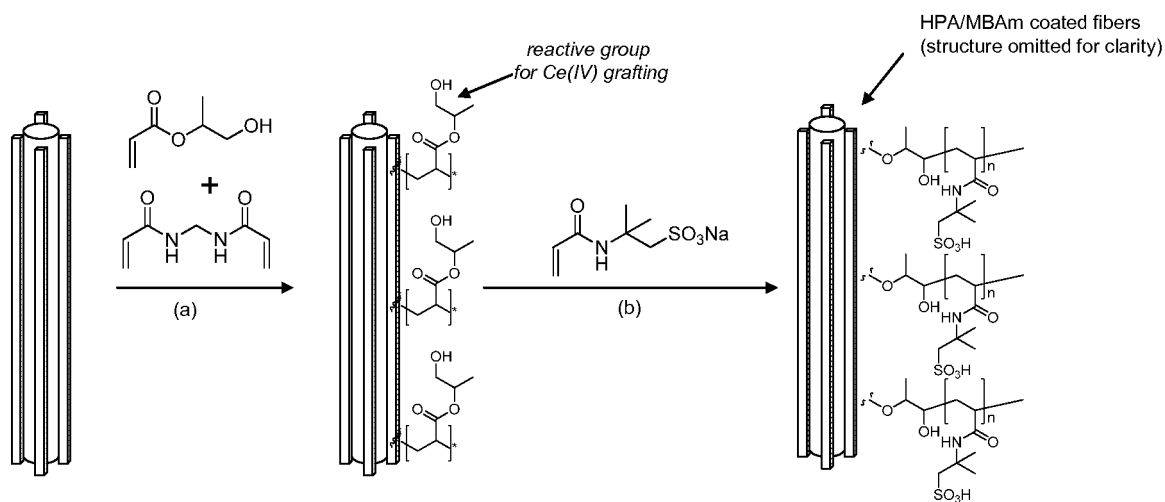
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FIG. 1e



Surface modification of high surface area fibers with pendant sulfopropyl cation exchange functionality (SP) (a) allyl glycidyl ether, sodium hydroxide, sodium sulfate, water, 50 °C, 12 hours. (b) 2-acrylimido-2-methyl-1-propane sulfonic acid, N,N-dimethylacrylimide, water, ammonium persulfate, 80 °C, 4 hours.

FIG. 1f



Surface modification of high surface area fibers with a pendant sulfopropyl cation exchange tentacle functionality (a) hydroxypropylacrylate, N,N'-methylenebis(acrylamide), ammonium persulfate, water, 80 °C, 4 hours. (b) 2-acrylamido-2-methyl-1-propanesulfonic acid sodium salt, water, ammonium cerium(IV) nitrate, HNO₃, 35 °C, nitrogen, 18 hours. *Note.* In the third graphic, the structure of the cross-linked HPA/MBAm coating is not shown.

Typical chromatogram: IgG CEX B/E on SP fiber media

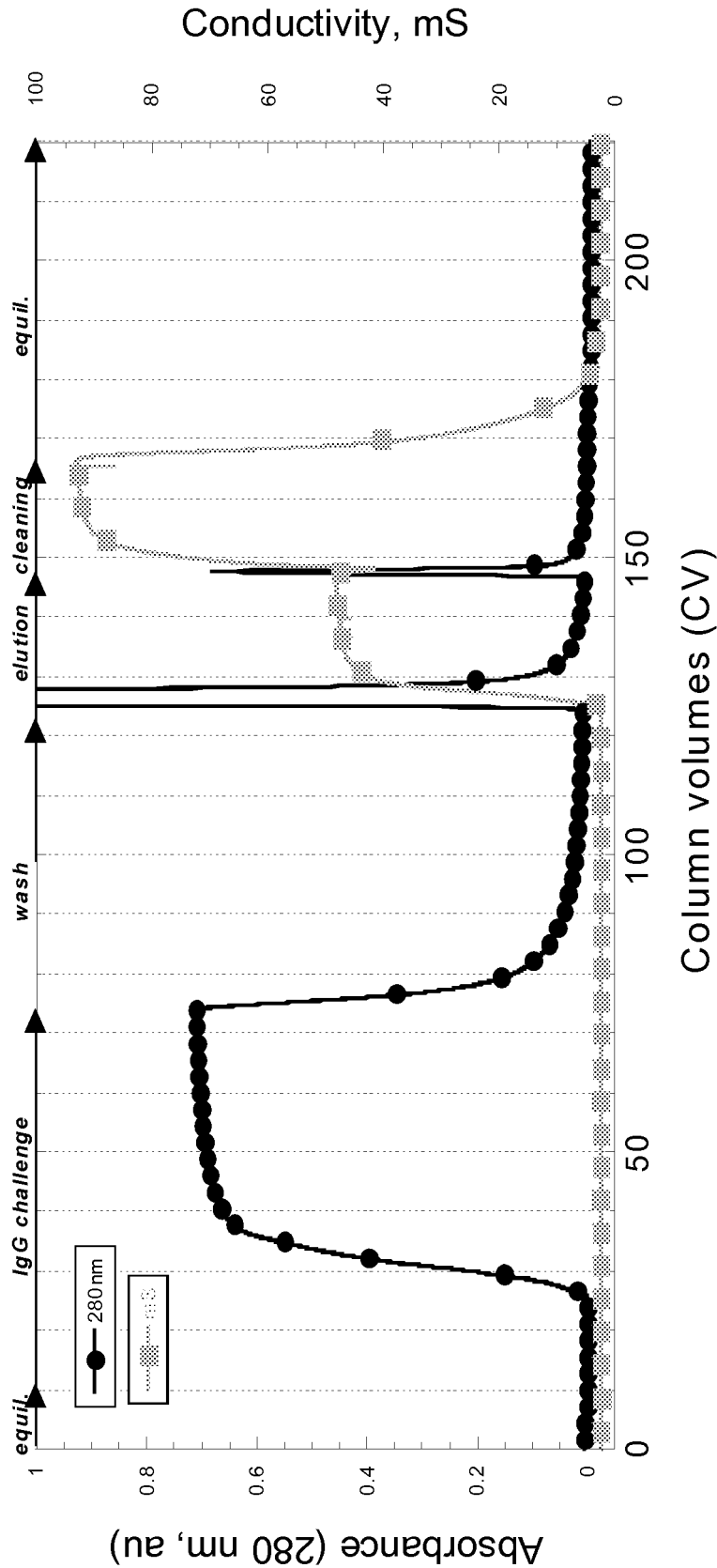


FIG. 2. Typical IgG breakthrough curve and elution peak for the SP-functionalized Alasso winged fiber cation-exchange media (SPF1). Equilibration/wash buffer: 50 mM NaOAc, pH 5; IgG load: 1.75 g/L IgG in 50 mM NaOAc, pH 5; Elution buffer: 0.5 M NaCl in 50 mM NaOAc, pH 5; Cleaning buffer: 0.5 M NaOH.

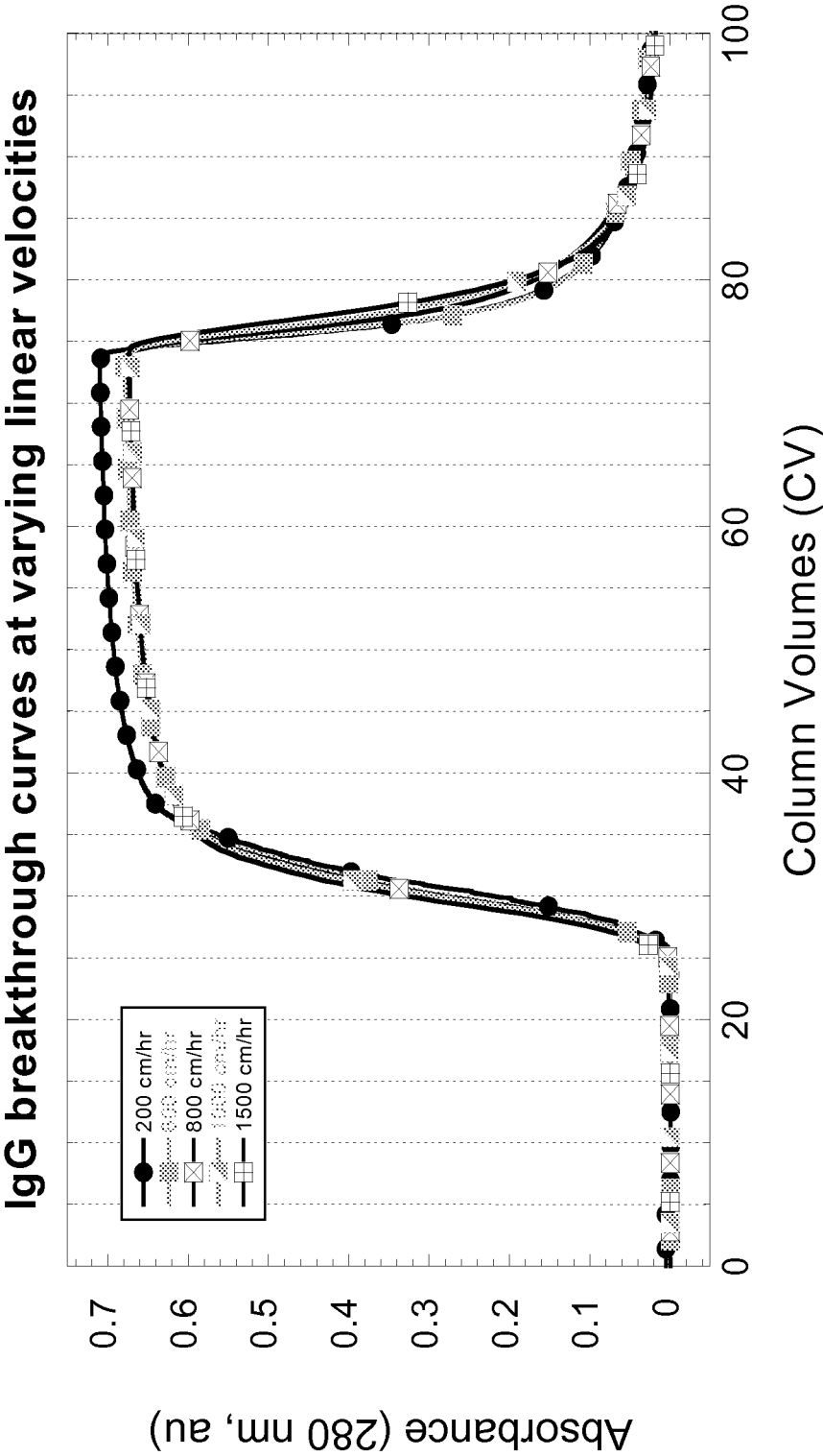


FIG. 3. IgG breakthrough curves for the SP-functionalized Allasso winged fiber cation-exchange media (SPF1) at varying linear velocities.

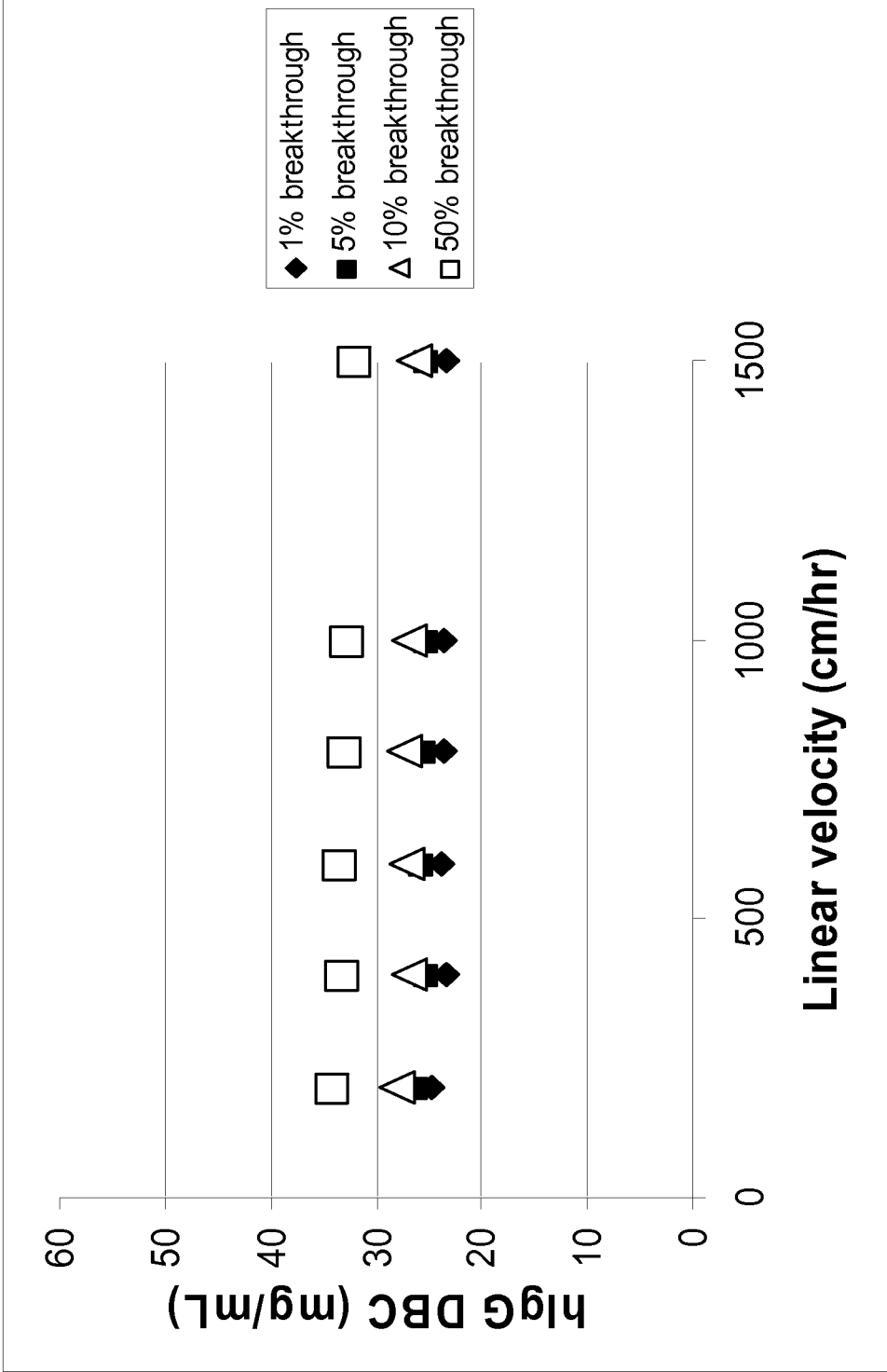


FIG. 4. Plot of IgG DBC for SPF1 at 1, 5, 10, and 50% breakthrough at varying linear velocities.

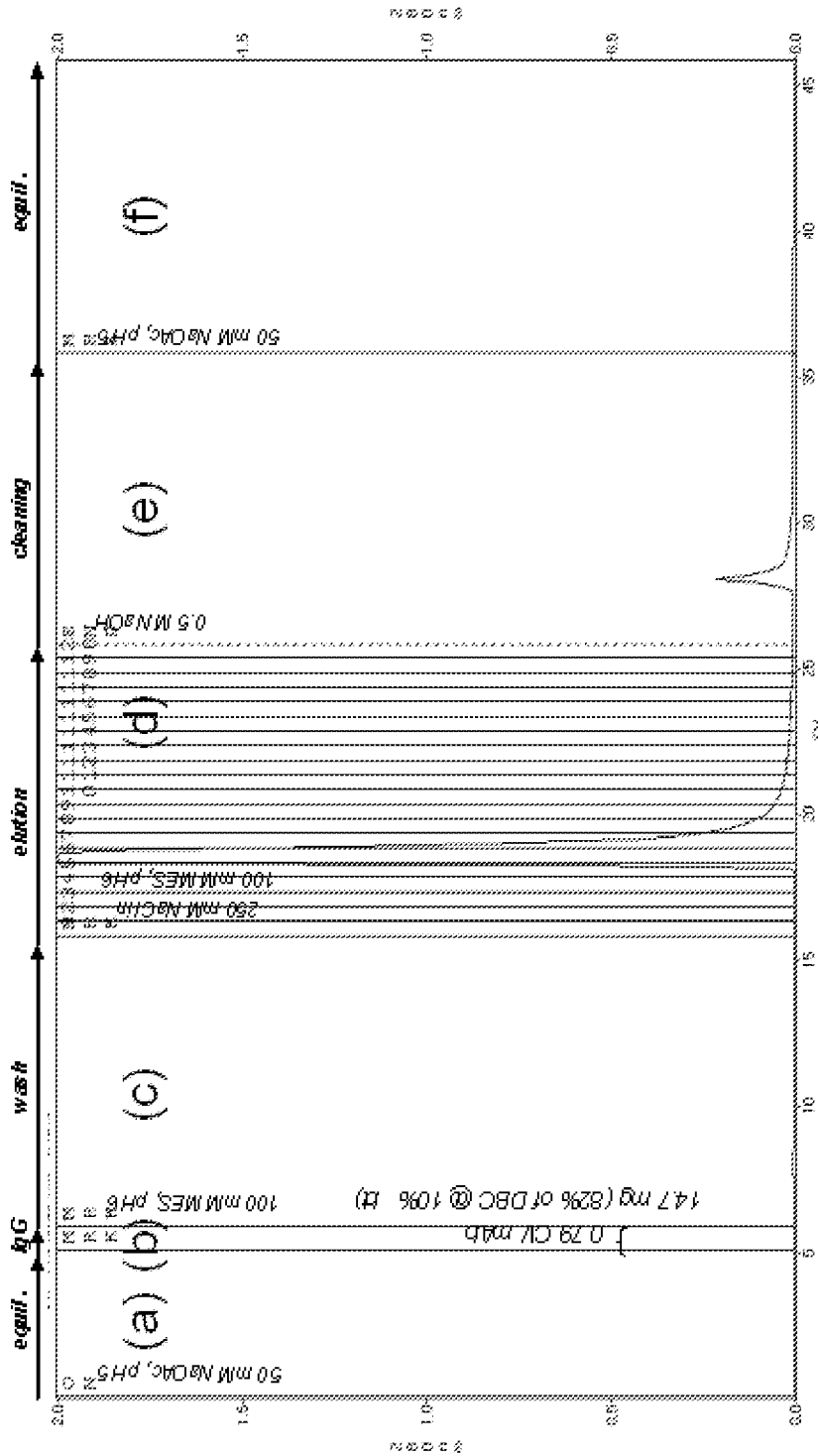


FIG. 5. Chromatogram from a mAb challenge experiment for the SP-functionalized Allasso winged fiber cation-exchange media (**SPF1**). Process details: (a) equilibration buffer, 50 mM sodium acetate, pH 5 (5 CV); (b) sample load, 6.7 g/L mAb challenge solution (Protein A eluate, 0.79 CV); (c) wash buffer, 100 mM MES buffer, pH 6 (10 CV); (d) elution buffer, 250 mM NaCl in 100 mM MES buffer, pH 6 (10 CV, 20 0.5 CV fractions collected); (e) cleaning buffer, 500 mM NaOH (10 CV); (f) equilibration buffer, 50 mM sodium acetate, pH 5 (5 CV).

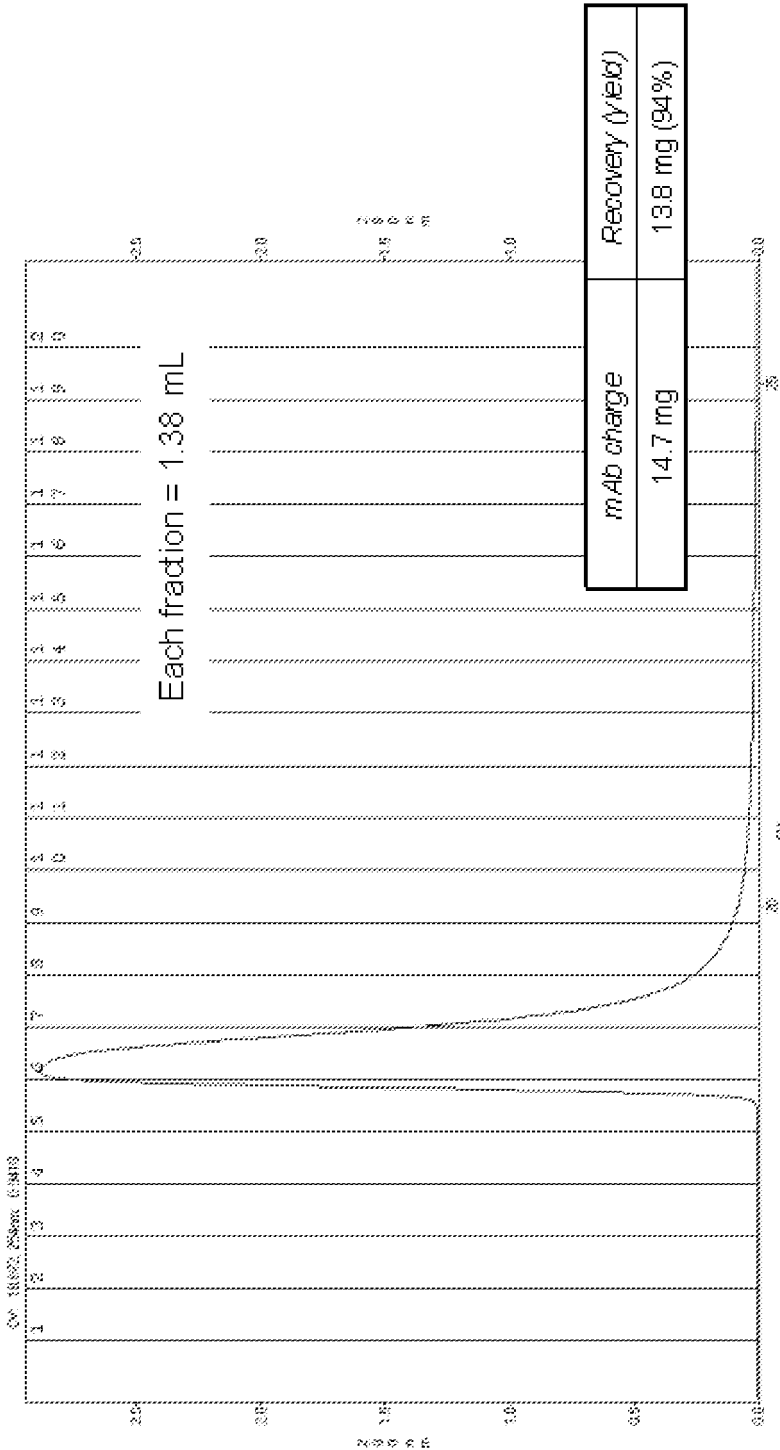


FIG. 6. Typical mAb elution peak for the SP-functionalized Alasso winged fiber cation-exchange media (SPF1). *inset:* Recovery analysis of the elution fractions by measurement of UV absorbance at 280 nm indicates 94% recovery of mAb.

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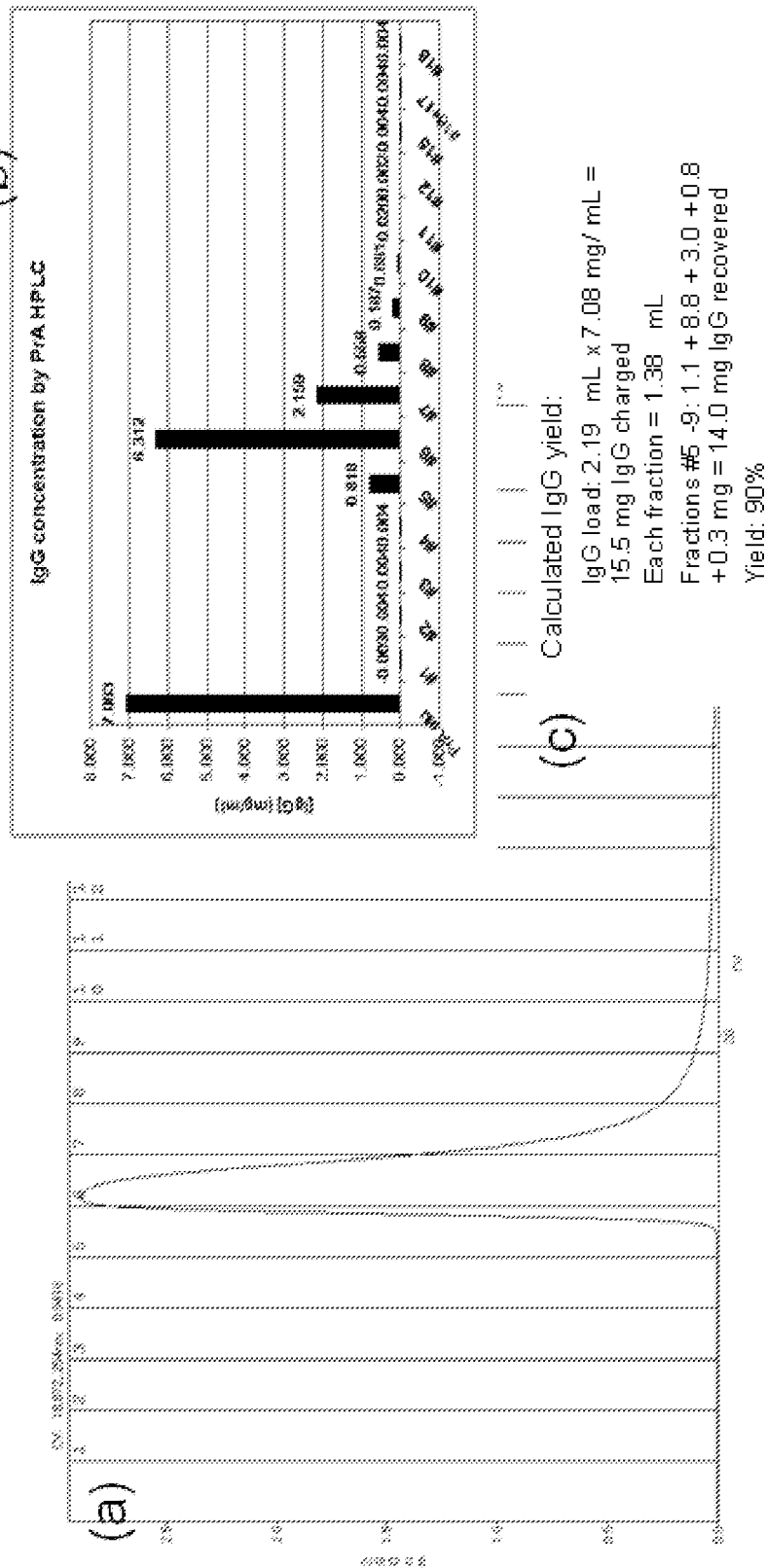


FIG. 7. IgG quantification by Protein A HPLC (a) The elution fractions from a mAb challenge experiment using the SP-functionalized Allasoo winged fiber cation-exchange media (SPF1). (b) IgG concentration (mg/mL) by protein A HPLC for the elution fractions #1-20. The mAb feed has a IgG concentration of 7.083 mg/mL (first column). (c) Calculation of IgG recovery by analysis of the measured IgG concentrations in elution fractions # 5-9.

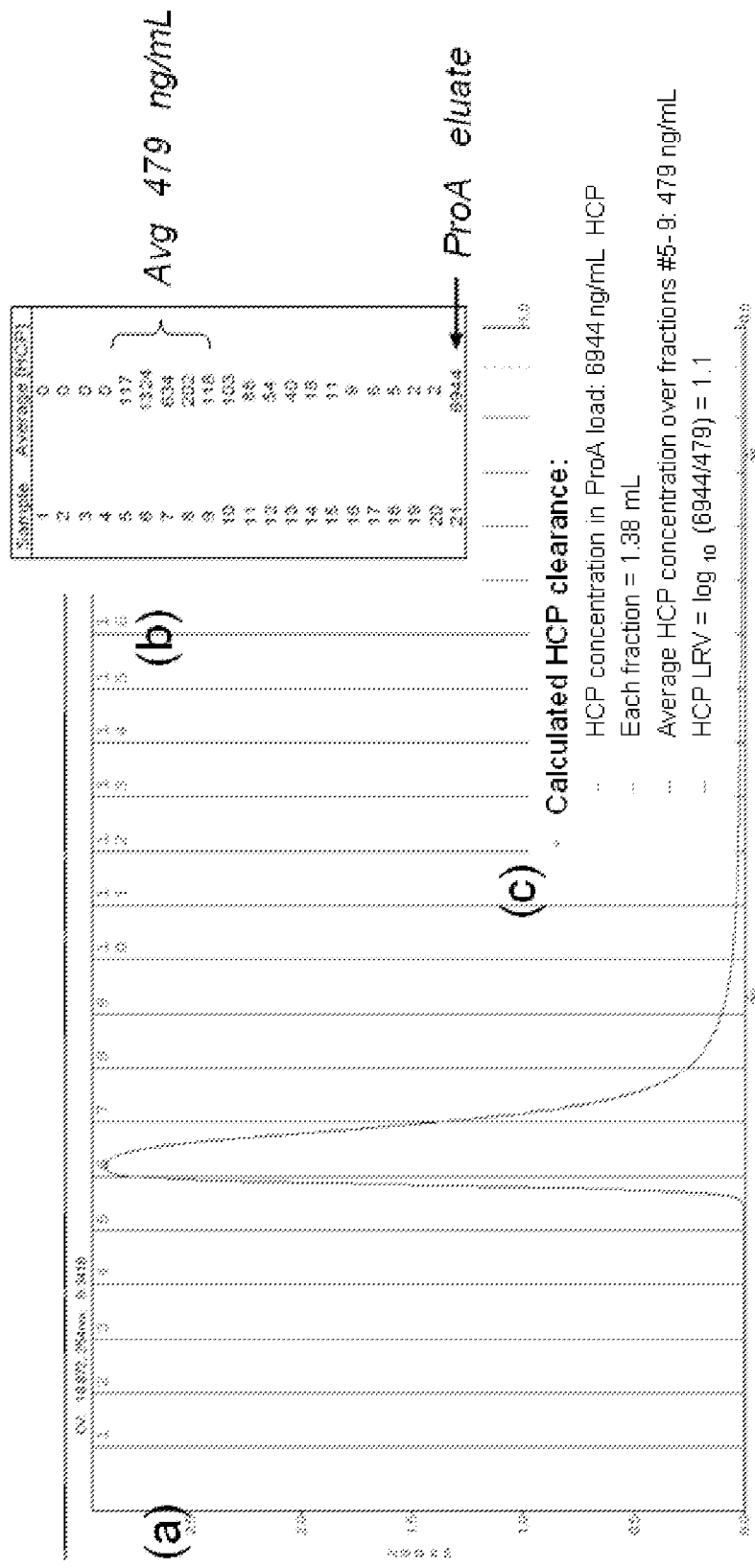


FIG. 8. CHO-HCP quantification by ELISA. (a) The elution fractions from a mAb challenge experiment using the SP-functionalized Allasoo winged fiber cation-exchange media (SPF1). (b) CHO-HCP concentration (ng/mL) by ELISA for the elution fractions #1-20. The mAb feed has an HCP concentration of 6944 ng/mL (line 21). (c) Calculation of HCP clearance (LRV) by analysis of the measured HCP concentrations in elution fractions.

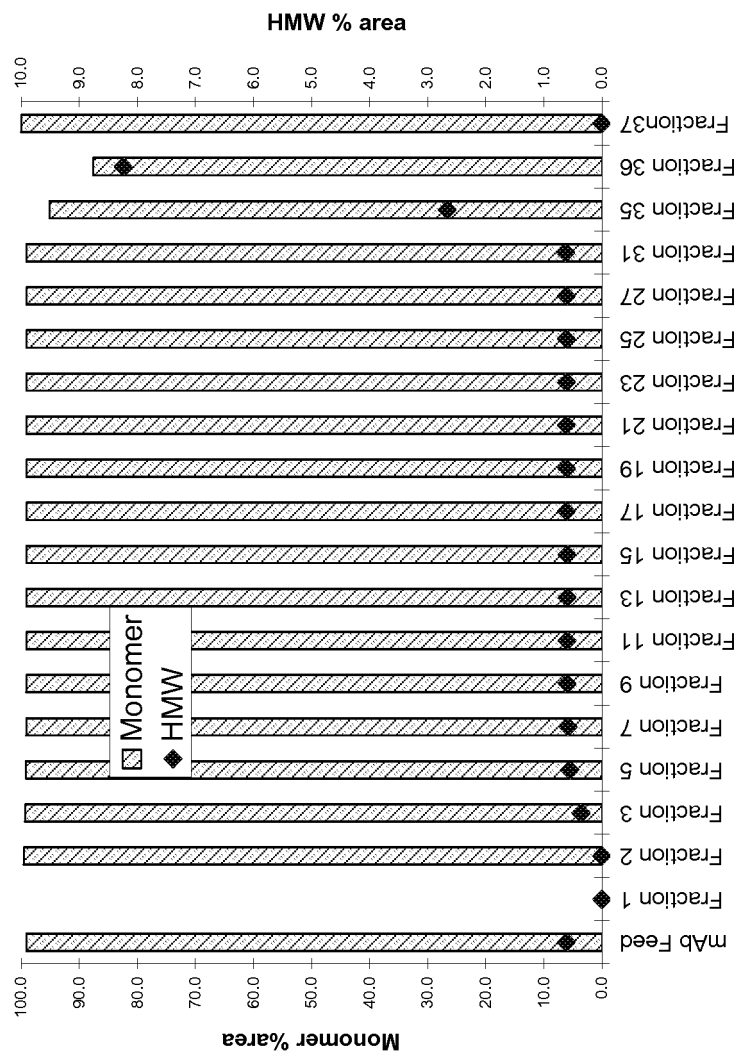


FIG. 9. Flow through aggregate clearance of a monoclonal antibody feed. Evaluation of a flow through aggregate clearance process comprising sulfoethyl- functionalized fiber media in a packed bed format (2.85 mL column volume, 0.35 g/mL packing density). Fractions analyzed by size exclusion chromatography (SEC) to find % monomeric and % HMW aggregated monoclonal antibody compositions for 31 flow through and 3 elution fractions (Fraction #35, 36, 37). Challenge: 6.9 g/L of a monoclonal antibody Protein A elution (pH 5, 19 mS) at a flow rate of 3.2 mL/min (residence time = 54 seconds).

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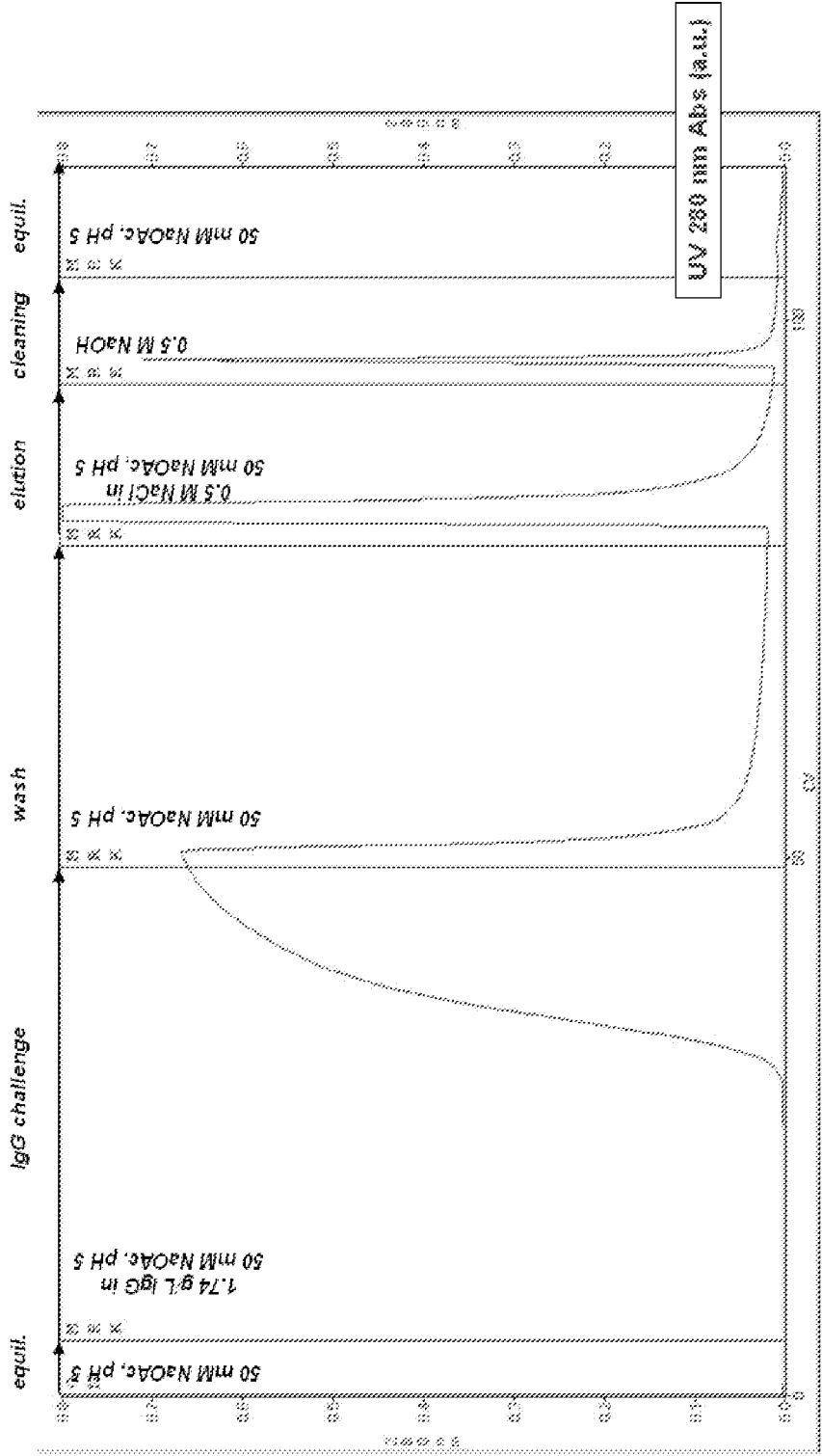


FIG. 10. Typical IgG breakthrough curve and elution peak for the SP-tentacle functionalized Allasso winged fiber cation-exchange media.

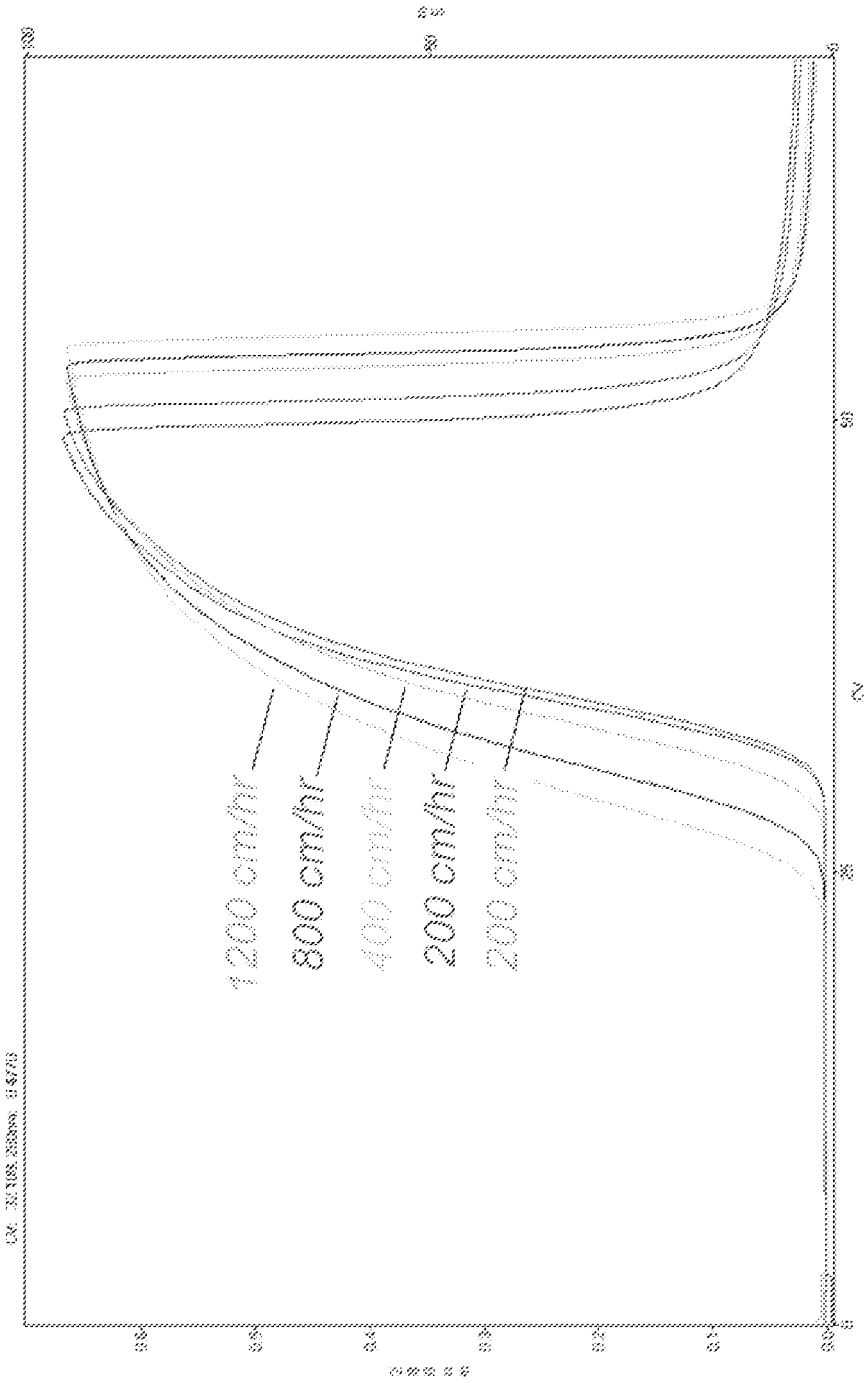


FIG. 11. IgG breakthrough curves for the SP-tentacle functionalized Alllasso winged fiber cation-exchange media at varying linear velocities.

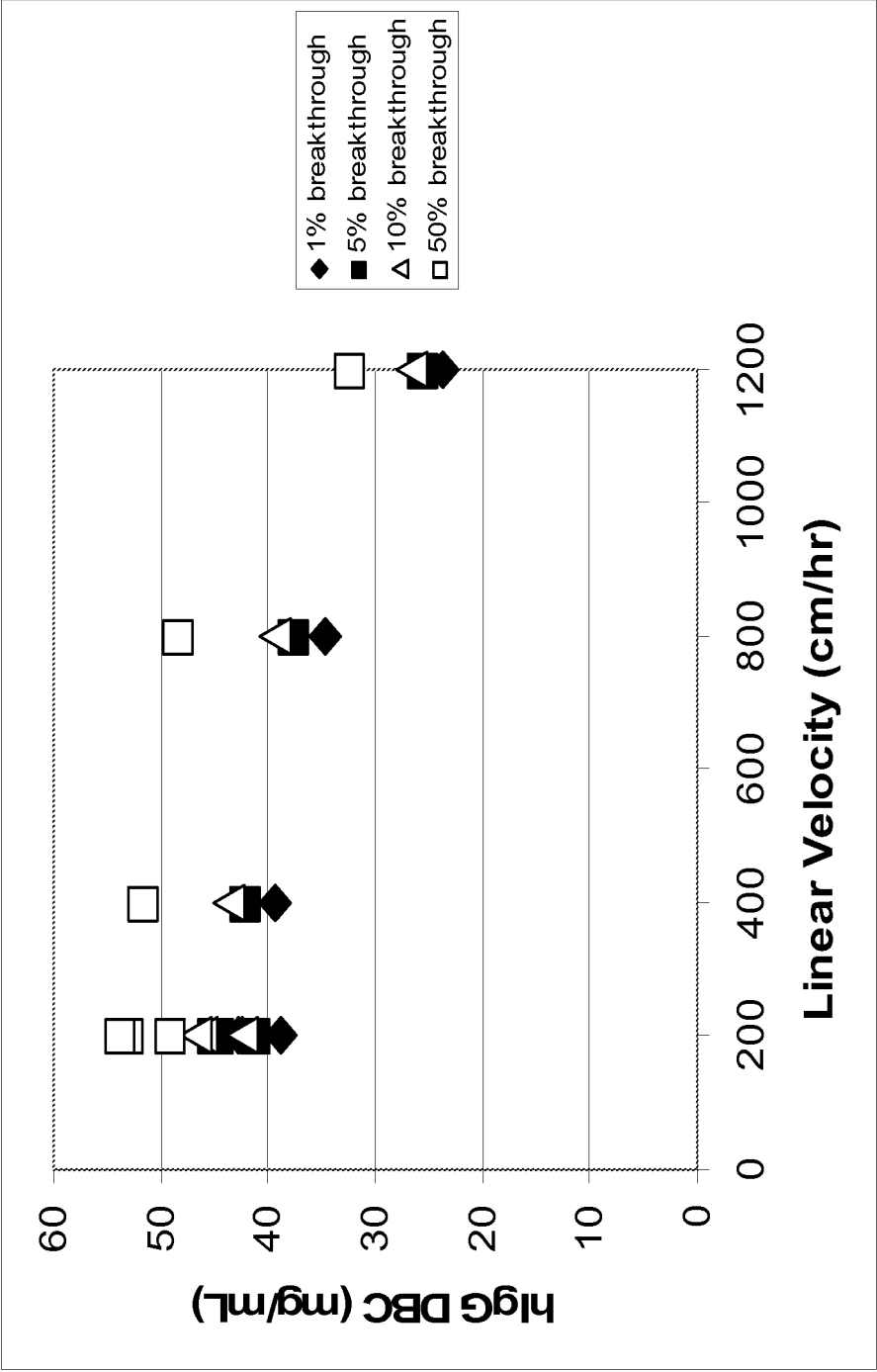


FIG. 12. Plot of IgG DBC for the SP-tentacle functionalized Allasso winged fiber cation-exchange media at 1, 5, 10, and 50% breakthrough at varying linear velocities.