Plants create sugar in the mesophyll cells of their leaves by photosynthesis. This sugar, mostly sucrose, has to be loaded via the bundle sheath into the phloem vascular system (the sieve elements), where it is distributed to growing parts of the plant. We analyze the feasibility of a particular loading mechanism, active symplasmic loading, also called the polymer trap mechanism, where sucrose is transformed into heavier sugars, such as raffinose and stachyose, in the intermediary-type companion cells bordering the sieve elements in the minor veins of the phloem. Keeping the heavier sugars from diffusing back requires that the plasmodesmata connecting the bundle sheath with the intermediary cell act as extremely precise filters, which are able to distinguish between molecules that differ by less than 20% in size. In our modeling, we take into account the coupled water and sugar movement across the relevant interfaces, without explicitly considering the chemical reactions transforming the sucrose into the heavier sugars. Based on the available data for plasmodesmata geometry, sugar concentrations, and flux rates, we conclude that this mechanism can in principle function, but that it requires pores of molecular sizes. Comparing with the somewhat uncertain experimental values for sugar export rates, we expect the pores to be only 5%-10% larger than the hydraulic radius of the sucrose molecules. We find that the water flow through the plasmodesmata, which has not been quantified before, contributes only 10%-20% to the sucrose flux into the intermediary cells, while the main part is transported by diffusion. On the other hand, the subsequent sugar translocation into the sieve elements would very likely be carried predominantly by bulk water flow through the plasmodesmata. Thus, in contrast to apoplasmic loaders, all the necessary water for phloem translocation would be supplied in this way with no need for additional water uptake across the plasma membranes of the phloem.