Stationary Phase Optimized Selectivity Supercritical Fluid Chromatography (SOS-SFC).

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In stationary phase optimized selectivity liquid chromatography (SOS-LC) the stationary phase becomes a tunable parameter by connecting column segments with variable lengths of different stationary phases. An optimization procedure and algorithm based on the PRISMA model for optimization of the mobile phase in LC was developed to apply this strategy for isocratic and gradient separations. An optimized column segment combination, giving the highest separation selectivity for all compounds in a mixture in the shortest possible analysis time, is predicted using the retention factors that are measured on the individual columns containing different stationary phases.

The PRISMA model is only valid if the retention factor $k$ is independent of column length and applied pressure. It’s shown to be reliable for conventional HPLC conditions, but the applicability in SFC is more difficult. The reason for this, is that in SFC, the retention factor decreases with increasing pressure. If a fixed outlet pressure is used, the column pressure increases with increasing column length, making it impossible to use measured retention factors on a given column length to predict retention factors on column segments of different lengths. In previous work, it was demonstrated that it is possible to perform SFC separations on a fixed column length at different flow rates keeping the retention factors of the compounds fixed by using the isopycnic way of working. This means that the average density in the column is kept constant by varying the outlet pressure. Because this isopycnic approach allows control of $k$, it is worthwhile investigating the implementation of the SOS-LC model for SFC separations. In this work, stationary phase optimized SFC was performed and shown to be viable if a fixed average column pressure is used for all measurements by varying the outlet pressure.