The importance of mechanical stability in process-scale chromatography

YMC

Abstract

The use of mechanically stable, spherical particles is an important economic aspect in a chromatographic process and also a matter of sustainability. **A rigid resin can be used longer and re-packed more often before it requires replacement**. The mechanical robustness directly determines the lifetime of the packed column bed. Naturally, particles that are damaged by pressure or shear forces over the course of time will release fines. These fines do not only clog the column frits, but also the flow channels of the packing materials, resulting in a constant increase in backpressure. This effect is even more pronounced during the repacking of stationary phases. The comparison shows nicely the effects described below.

Backpressure increase with conventional silica

Conventional silica resin is widely used in preparative scale chromatography. It is packed in self-packing large scale columns. The idea is to reuse it to diminish the costs. Therefore, the resins are unpacked after usage. After an efficient cleaning the gel is then repacked again. After each re-packing, the pressure monitoring shows that the system backpressure has a significant increase after every cycle (please see figure 1).

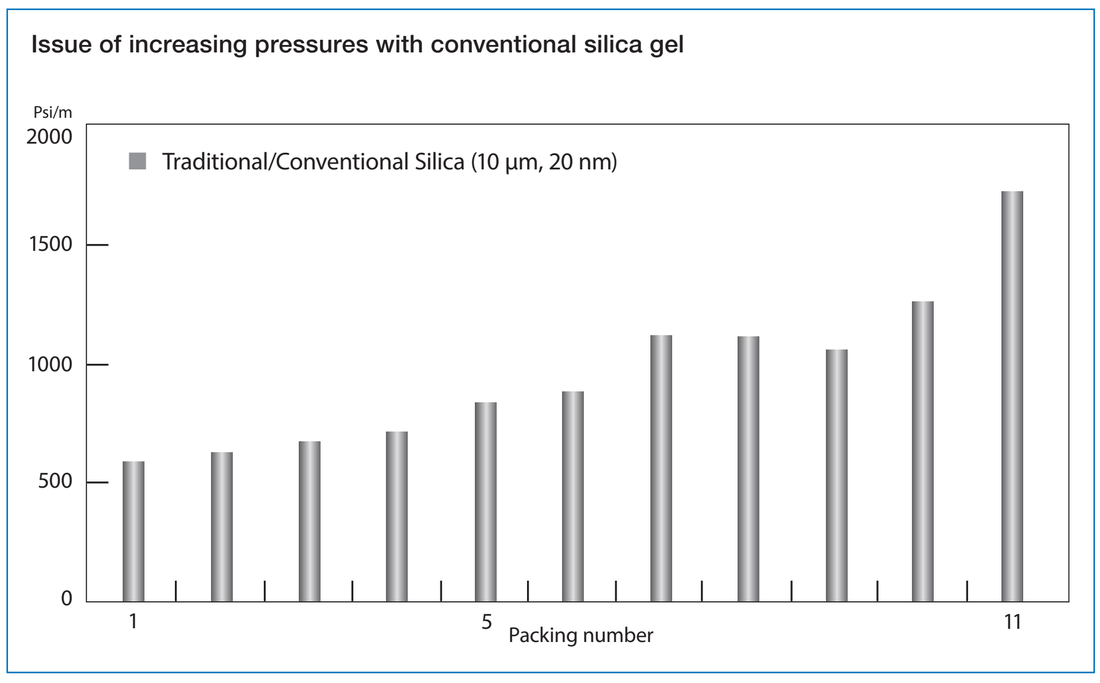

Figure 1: Pressure vs. number of packing cycles for a conventional silica.

Conventional silica-based gels can only be used a small number of repackings due to a high increase of backpressure.

Multiple column re-packing with stable and low backpressure

In order to overcome this behaviour, an innovative stationary phase needs to be implemented. A modern state-of-the art gel undergoes numerous repacking cycles. In contrast to the conventional silica, the monitored backpressure for modern **YMC-Triart Prep shows a constant low pressure curve**. This allows extended use of the packing material. In addition to the continued and constantly low pressure curves, the initial backpressure is approx. 20–30% lower compared to conventional silica gels. Thereby, higher flow rates and a significantly longer lifetime of the packed column can be achieved.

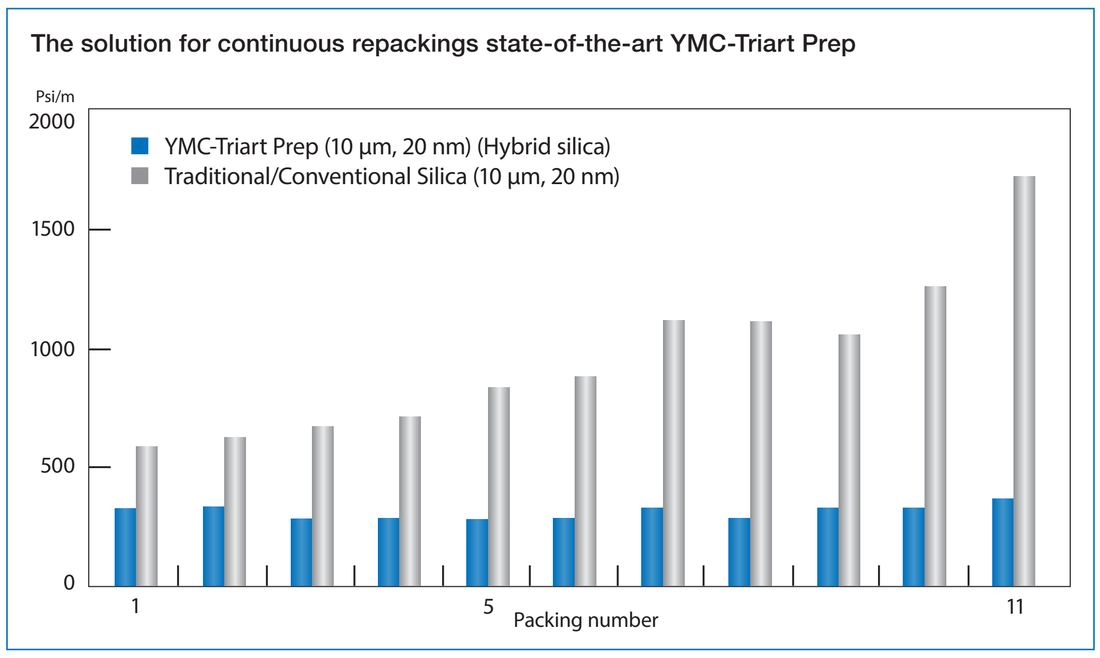

Figure 2: Pressure vs. number of repackings for YMC-Triart Prep.

How to understand these findings

The best insights are gained by SEM-scanning of resins. Firstly the traditional silica packing has been analysed. In figure 3a and figure 3b the conventional silica is shown after the first and the 11th packing process. In figure 3a it becomes obvious that the initial particle shape is defective. Figure 3b showing the same resin after the 11th packing proves that more fines have been generated. Over the course of time such fines will accumulate within the flow channels. They increase the operating backpressure. But even more profound, the irregular shaped particles are stressed by shear-forces, which cause an increase of fines.

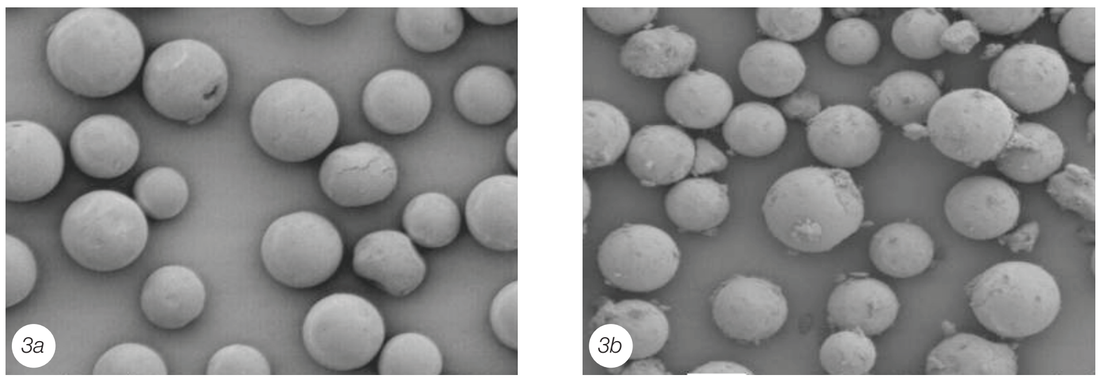

Figure 3a and 3b: Conventional silica during repacking: 3a after packing process No. 1 and 3b after packing process No. 11.

When the modern stationary phase is examined it clearly shows the differences

First of all, the modern YMC-Triart Prep consists of regular shaped particles. Fines are absent. The optimal particle shape of YMC-Triart Prep enables a uniform packed bed. Consequently, evenly distributed flow channels are created. This has a direct influence on the system backpressure, which is lower compared to other silicas. In addition, the repacking process is less harmful to the particles. The particles are exposed to lower shear forces and can be ultimately used longer.

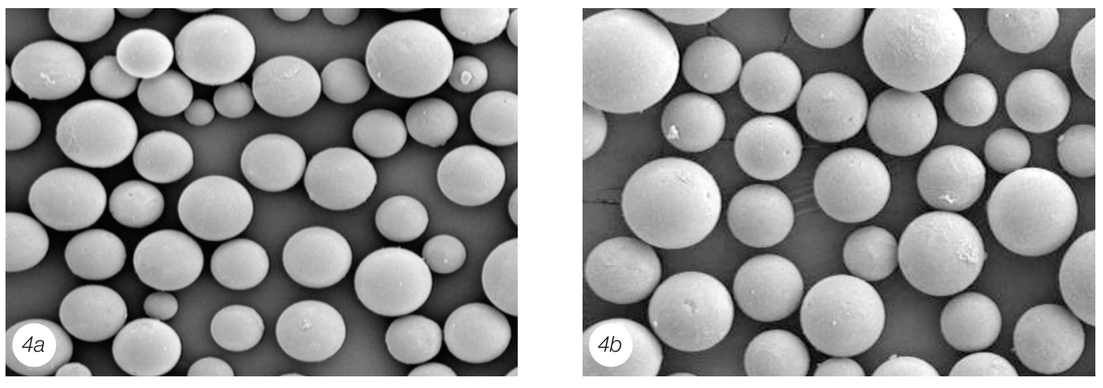

Figure 4a and 4b: Modern YMC-Triart Prep during repacking: 4a after packing process No. 1 and 4b after packing process No. 11.

Conclusion

This study demonstrates the benefit of using mechanically stable particles. It is an important economic aspect in a chromatographic process and also a matter of sustainability. The results of this repacking examination shows that a **rigid resin can be used longer and re-packed more often before it requires replacement**. The mechanical robustness directly determines the lifetime of the packed column bed.

The SEM analysis showed that particles that are damaged by pressure or shear forces over the course of time will release fines. These fines do not only clog the column frits but also the flow channels of the packing materials, resulting in a constant increase in backpressure. This effect is even more pronounced during the repacking of stationary phases.

YMC-Triart Prep

- **Lower backpressures at initial conditions**
- **Constant low backpressures with repeated repacking**
- **Increased flow rates and longer lifetime**

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