High Performance Structured Packings – Making CO2 capture and reactive distillation viable

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In chemical process industries, process intensification is generally oriented towards increasing mass transfer efficiency of unit operations, including separations and reactions. Most recently impressive advances have been achieved by coupling reactions and separation by distillation (or absorption). Indeed reactive distillation can be performed in an effective way using modular catalytic structured packings, which are designed and arranged to enable under counter-current flow conditions both reaction and separation. The former occurs in liquid phase, inside catalyst containing compartments, which are separated by one or more corrugated structured packing sheets that provide interface for separation related vapour/liquid contact. Internal liquid holdup (inside catalyst containing pockets) affects reaction efficiency and external (packed bed) liquid holdup mass transfer efficiency. However the specific column liquid load is determined by distillation operation, which means that this can be both sufficient and insufficient with respect to reaction requirements. This becomes an even larger concern in case of performing reactive distillation in conjunction with dividing wall distillation columns, where a certain liquid split above the partition wall can be imposed by mechanical means, but the pressure drop is the only “instrument” to control the split of vapour flows below the partition wall, which however must be adequate to ensure required separation performance. Regarding reaction side, it is very important to know exactly the internal liquid reflux, and employing advanced measurement techniques such as X-ray computed tomography looks to be promising in this respect. Pressure drop control becomes essential, and by employing sheets of high performance packings as constituents of catalytic packing compensates significantly for increase in overall pressure drop due to rather low porosity of catalytic structured packings. Fortunately, in reactive distillation applications often a relatively high pressure drop can be tolerated.

However there are situations where each millibar of pressure drop counts and it appears that this will certainly be the case with implementation of post-combustion CO2-capture technologies. Immense volume of off-gas available at atmospheric pressure needs to be pushed through absorption tower of huge dimensions to effect removal of 90 % of CO2 using some of proven solvents. It is questionable whether this goal can be reached in practice in a viable way even by applying state of the art

high performance structured packings as gas/solvent contactor. This and other equipment performance related uncertainties and challenges will be highlighted and discussed, including absurd situation with solvent recovery energy requirement.