INTALOX® ULTRA™ RANDOM PACKING – PUSHING THE ENVELOPE

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Abstract
INTALOX® ULTRA™ random packing is a new generation random packing that exhibits better efficiency, lower pressure drop and higher capacity than previous generations of random packing. These characteristics translate into savings on new towers, but also open up interesting revamp opportunities.

Keywords: Random Packing, Efficiency, Capacity, Pressure drop

1. Introduction
Random packing is extensively used in gas processing and high pressure distillation applications. These applications generally operate at fairly high specific liquid rates. Random packing offers distinct benefits over trays and structured packing in some of these applications.

Glass balls were used as random packing as early as the 1820's. By the 1850's pumice stone or pieces of coke were used as random packing. In the 1880's Ilges started using ceramic balls as random packing in azeotropic distillation towers. By the start of the 1900's hollow ceramic and metal balls were used as random packing. Raschig realized the importance of having the internal surface area of the random packing take part in mass transfer and in 1914 patented the use of thin-walled metal cylinders as random packing. The 1950's and 60's saw the introduction of metal PALL rings. The Pall ring is a ring-shaped packing element with a more open structure. In 1977 IMTP® random packing was developed. IMTP® packing represented a change in direction from the ring-shaped structure – it is described as a saddle-shaped element. CMR® random packing BET® Ring packing represented a return to the ring-shaped structure. The 1990's saw the introduction of the FLEXIMAX® saddle-shaped random packing and the Raschig Super Ring™. Through all these developments IMTP® random packing has cemented its place as the premier high performance random packing.

Given the performance of the aforementioned packing, the question could be asked: Has random packing reached the pinnacle, or is it possible to get another step change in performance?

2. Random Packing Characteristics
Pall rings were a significant advance because they opened up the interior surfaces of the rings to vapor and liquid flow as compared with earlier Raschig rings. A modified Pall ring with a reduced height to diameter ratio was later introduced as the CMR® ring. The latter ring is believed to preferentially itself in the packed bed in a manner that reduces the pressure drop. IMTP® packing elements combine the increased surface area advantages of the INTALOX® saddle with the interior projecting fingers of the Pall ring. A little over ten years ago, the Rashig-Super ring was introduced. It is claimed that this packing promotes the spreading of liquid films as opposed to a combination of films and droplets. When looking at all of the aforementioned packing elements from different vantage points, it is evident that from certain angles it is possible to see through the packing element, whereas it is impossible to see through the element from other angles. These packing elements thus present different “looks” to the vapour – depending on the orientation of the packing elements.

There are a number of disadvantages to packing elements that, when they are dumped into a column, rely on non-random preferential orientation of the elements for part of their performance advantage. Not only the pressure drop, but also the amount of mass transfer, depends on the orientation of the element to the overall direction of vapor and liquid flow. For example, when a packing element lies preferentially on its flat side, downstream surfaces within the element are shielded by upstream surfaces of the element. In effect downstream surfaces lie in the wake of upstream surfaces and this is detrimental to the mass transfer that is supposed to take place on the downstream surfaces. This effect reduces mass transfer and increases pressure drop. It could be contended that a random packing element that looks the same from all vantage points could overcome these disadvantages.
3. Development of an improved random packing
The considerations in section 2 above prompted the development program that has led to the creation of the INTALOX® ULTRA™ random packing described in this paper. A prime requirement for the new packing was high mass transfer, together with low pressure drop and high capacity, when the element was positioned in multiple different rotational orientations within the packed bed. Figure 1 shows an element of INTALOX ULTRA random packing.

INTALOX ULTRA random packing comprises a pair of curved side strips with inner and outer arched ribs extending from and between the side strips. The ribs are not all of the same height or shape, and some are discontinuous. The side strips are typically flanged to provide strength. Additionally, the ribs are misaligned from the longitudinal axis of the element which discourages nesting of one packing element with another. Nesting reduces mass transfer efficiency and can promote liquid and vapor channeling within the packed bed. The ribs of this packing are oriented in space to create an even distribution of surface area in the volume occupied by the packing element. This means that a significant portion of the surface area is inside the packing element. It is important that the outer shell of the packing element is relatively open to allow the surface area that is created on the inside to be used effectively. It is also important to have the packing element exhibit this open structure from all angles. The INTALOX ULTRA packing has open, easily accessible fluid flow paths and presents a relatively uniform surface area distribution when viewed at multiple angles, which results in orientation-independent element performance.

4. INTALOX ULTRA packing performance
Figures 2 to 5 show the pressure drop and HETP of INTALOX ULTRA packing under total reflux conditions in a system comprising of light hydrocarbon isomers. For comparison, data are also shown for IMTP 40 and IMTP 50 packing. The IMTP data were obtained in the same pilot plant under the same conditions as the INTALOX ULTRA packing data. The vapour density was 1.05 lb/ft³ and the liquid density 34 lb/ft³.

Figure 2 clearly shows one advantage of the new packing. INTALOX ULTRA A packing has almost the same capacity as IMTP 50 packing and yet has a significantly lower HETP – the HETP value almost rivals that of IMTP 40 packing. Figure 3 shows that the capacity and pressure drop of INTALOX ULTRA A packing is close to that of IMTP 50 packing, and significantly better than that of IMTP 40 packing.

Figure 4 shows that the HETP of INTALOX ULTRA L packing is the same as that of IMTP 50 packing, yet the capacity of the INTALOX ULTRA L packing is significantly higher. From Figure 5 it can be seen that the INTALOX ULTRA L packing shows lower pressure drop and higher capacity than IMTP 50 packing. The pressure drop and capacity of the INTALOX ULTRA L packing rivals that of IMTP packing larger than the number 50 size.
Figure 2. HETP of INTALOX ULTRA A packing relative to IMTP packing

Figure 3. Pressure drop and capacity of INTALOX ULTRA A packing relative to IMTP packing
5. Conclusions
INTALOX ULTRA random packing is a breakthrough product that exhibits efficiency, pressure drop and capacity superior to that of previous generations of random packing.

Figure 4. HETP of INTALOX ULTRA L packing relative to IMTP packing

Figure 5. Pressure drop and capacity of INTALOX ULTRA L packing relative to IMTP packing