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Core-Shell Particle Technology in Pharmaceutical Analysis

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The column is the heart of chromatographic system, common secret among all chromatographers. This statement is the most impressive that I remember from my early steps using any chromatographic science. But what happens when this heart becomes so hard as a stone? Oppositely to real life consequences, the result is that sensitivity is higher. And this heart of stone makes the life of the chromatographer much more interesting and easier. Yes, you have correctly guessed. I am talking about core shell technology. This technology allows us to achieve ultra high performance liquid chromatography using the conventional equipment available in any laboratory that involves HPLC as routine analytical technique.

Compared to classical fully porous silica materials, core shell particles (Figure 1) consist of a solid core and a porous shell. Typical 2.6 μm or 2.7 μm or smaller eg 1.7 μm diameter particles enable high speed and high resolution separations keeping the resulting backpressure low enough so that no special and highly sophisticated instrumentation is necessary. The unique mass transfer characteristics of such columns are the ones to "blaim" for not asking for Ultra high performance systems. The father of the technique is Dr. Jack Kirkland, who is considered to be one of the "founders" of HPLC [1].

This state of the art technology is also known as solid *core* particles or Fused-*core* particles or superficially-porous, or semi-porous, or pellicular, all referring to similar stationary phases.

Speed, resolution, sensitivity, peak capacity, high number of theoretical plates, high productivity and solvent saving are among the most important advantages for core shell particles who present similar efficiency to those of sub 2-μm porous particles under a lower back pressure [2].

Reversed phase C_{18} columns can be applied for acidic, basic and neutral analytes such as (sulfonamides; anabolic steroids; anti-psychotics; beta blockers; etc), excellent pH stability, C_{18} endcapped for analysis of very polar compounds, basic pharmaceutical ingredients, water soluble vitamins, catecholamines etc.

Some of the commercially available solid core columns are Kinetex™ *core-shell* by Phenomenex, BlueShell® by Knauer, Accucore™ by Thermo Scientific, CAPCELL CORE by Shiseido, HALO TM (fused-core) from Advanced materials technology inc. Ascentis® Express by Sigma-Aldrich and many others [3-5].

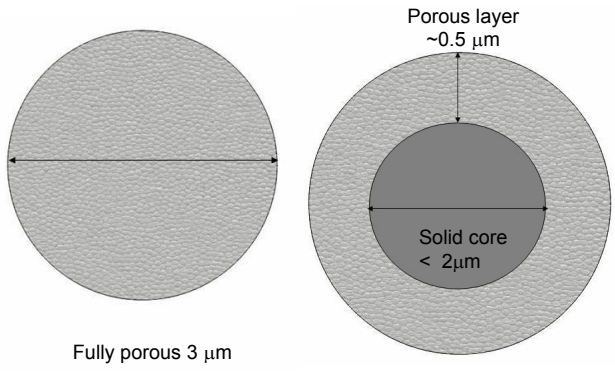

Figure 1: Fully porous and core shell particles.

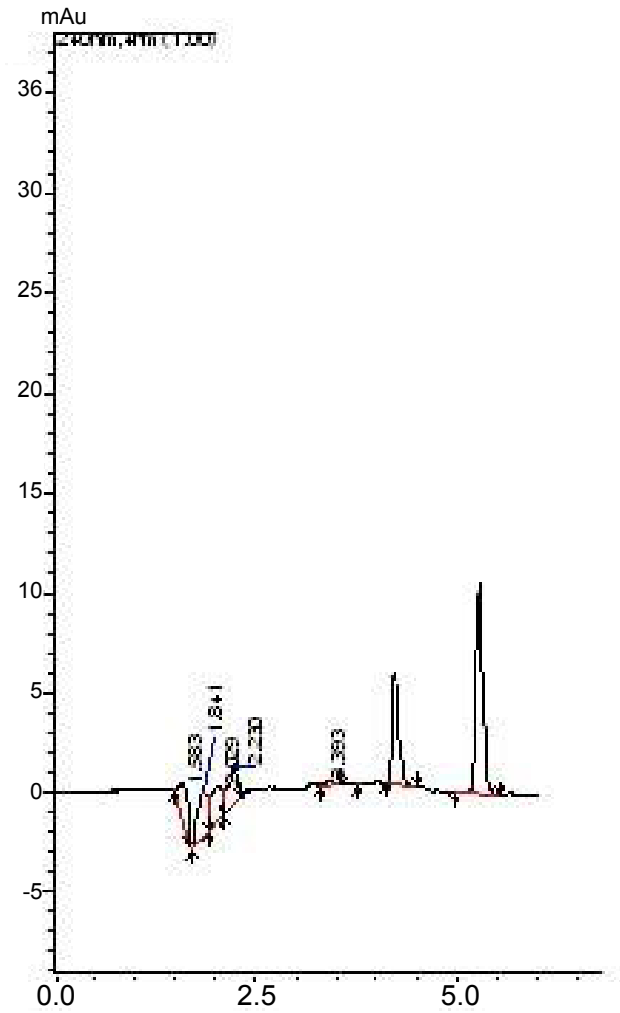

Figure 2: Typical chromatogram of ampicillin and penicillin in veterinary drug using a core shell column.

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In our lab we have applied KINETEX ™ 2.6 μm, (150 mm × 4.6 mm) for the determination of eight antimicrobial agents from two different classes: penicillins and amphenicols, using a typical 400 bar HPLC equipment [6].

Chloramphenicol (CHL), thiamphenicol (THI), florfenicol (FLO), cloxacillin (CLO), dicloxacillin (DICLO), oxacillin (OXA), amoxicillin (AMO) and ampicillin (AMP) were determined. The applicability of the proposed method, was proved by florfenicol determination in NUFLOR injectable solution (labeled concentration 300 mg/mL) supplied by Schering-Plough Animal Health USA, as well as by ampicillin and dicloxacillin determination in Cloxalene Plus injectable solution (labeled concentration 11 g/100 mL for AMP and 5g/100 mL for DICLO, supplied by FATRO S.p.A. Bologna, Italy. Both pharmaceuticals are intended for veterinary use. The analysis was completed within 17 min. The method was validated and proved to be suitable to monitor the concentration of the studied antibiotics in drug formulations.

Narrower peaks were observed with higher sensitivity and better precision in peak area and retention time. The conclusion was that ultra high performance was achieved by using a common 400 bar HPLC instrument (Figure 2).

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