numbers for a series of higher fatty acids and alcohols were determined to be 8–12 for polyamide and 4–9 for cellulose (99).

Homemade mixed sorbent layers have been used by various workers to increase the resolution of certain samples compared to that obtained on the separate phases. Binary layers that have been reported include silica gel–alumina (100), kieselguhr–alumina, alumina–calcium sulfate, magnesia–kieselguhr, cellulose–silica gel, polyamide–silica gel, polyamide–kieselguhr, polyamide–cellulose, polyamide–glass powder (similar to silica gel), silica gel–kieselguhr (101), and alumina–cellulose (102). The properties of these mixed layers are usually somewhere between those of the two separate phases but are impossible to predict or explain with certainty. Information on and applications of mixed layers are mostly contained in older standard TLC texts and reviews.

## B. Partition, Preadsorbent, and Impregnated Layers

Compounds that have the same polarity and functional group and migrate together on silica gel can often be resolved by partition TLC. Crystalline cellulose (AVICEL) or high-purity fibrous cellulose serves primarily as a support material for the NP liquid–liquid partition TLC of polar substances, such as amino acids (103), and water-soluble biopolymers, although adsorption effects cannot be excluded in many cases. The stationary phase is either water or an impregnated polar liquid such as dimethylformamide. Cellulose used to prepare thin layers differs from that in chromatography paper mainly by having shorter fiber length (2–20 $\mu$m), resulting in the same migration sequence for a series of compounds developed with a given mobile phase but less diffusion and higher efficiency than in paper chromatography.

Kieselguhr (diatomaceous earth) (104) and synthetically prepared silicon dioxide (Merck silica 50,000) (105) are small surface area, weak adsorbents that are used as the lower 2–4 cm inactive sample application and concentrating zone in the manufacture of silica gel and $C_{18}$ preadsorbent plates. Samples applied to the preadsorbent region usually develop into sharp, narrow bands at the preadsorbent/sorbent interface, leading to efficient separations with minimum time and effort in manual application of samples and possible sample cleanup by retention of interferences in the preadsorbent.

Layers have been impregnated with buffers, chelating agents, metal ions, or other compounds to aid in the resolution or detection of certain compounds (see Ref. 106 for a review). If plates are prepared in the laboratory, the reagent is usually added to the stationary-phase slurry. Reagents are applied to precoated plates by spraying, brushing, horizontal or vertical dipping, development, or overdevelopment (107). Analtech precoated plates are available already impregnated with potassium oxalate to facilitate resolution of polyphosphoinositides, magnesium acetate for phospholipids, 0.1 M NaOH for organometallics and acidic compounds, silver nitrate for compounds with carbon–carbon double bonds such as fatty acids (107), and carbomer for mannitol and sorbitol analysis according to several Pharmacopoeia methods, as well as plates containing ammonium sulfate for detection of compounds as fluorescent or charred zones after heating (vapor-phase fluorescence detection). Other reagents that have been added to thin layers to improve separations include ion-pairing reagents (108), molybdic acid (for separation of carbohydrates), boric acid (carbohydrates and lipids), polycyclic aromatic hydrocarbons (PAHs), (formation of charge transfer complexes with numerous organic compounds), surfactants (sulfa drugs and substituted pyrazoles) (109), EDTA (reduces tailing of drugs) (110), urea (wax esters and hydroxybenzenes), ferric ion (carboxy- and hydroxybenzenes), cupric ion (glucose and sorbitol), caffeine (PAHs), and ammonium sulfate (surfactants). The separation of amino acids and their derivatives and enantiomers by impregnated TLC was reviewed by Bhushan and Martens (110a).

## C. High-Performance Layers

High-performance (HP) plates (10 × 10 or 10 × 20 cm) are produced from sorbents having narrow pore and particle size distributions and an apparent particle size of 5–7 $\mu$m instead of 8–10 $\mu$m for 20 × 20 cm TLC plates (23). Layer thickness is usually 100–200 $\mu$m for HPTLC plates compared to 250 $\mu$m for TLC, but ultrathin (10 $\mu$m) layers of monolithic silica gel have recently been described (110b).