The pathways that exist in porous membranes used to deliver drugs form fractal percolating paths. For a homologous series of 4-alkylanilines, the fractal dimension $D$ is calculated as a model for transdermal delivery drugs. Program TOPO is used for the calculation of the solvent-accessible surface $AS$, which is denoted by the centre of a probe, which is allowed to roll on the outside while maintaining contact with the bare molecular surface $S$. $AS$ depends on the probe radius $R$. For 4-alkylanilines, the quadrupole moment $ı$ is doubled. The hydrophobic contribution to $AS$ is doubled while its hydrophilic part remains constant. $D$ increases 11%. Geometric descriptor and topological index results are in agreement with reference calculations. The 1-octanol–water partition coefficient $\log P$ increases. The molar concentration of organic compounds necessary to produce a 1:1 complex with bovine serum albumin via equilibrium dialysis, $\log 1/C$ increases. The hydrophile–lipophile balance (HLB) decreases. The linear correlation between $D$ and $ı$, and non-linear correlations between $D$, $\log P$, $\log 1/C$ and HLB point to a homogeneous molecular structure of the 4-alkylanilines. The comparison with phenyl alcohols shows that their greater dipole moments cause lower hydrophobicity.