

Formula 1

Content placeholder

Formula 2

Content placeholder

Formula 3

Content placeholder

Detailed Explanation

Adsorption is a surface-based mass transfer process where molecules from a fluid phase (gas or liquid) adhere to the surface of a solid adsorbent via physical (van der Waals) or chemical (chemisorption) interactions. The IChemE Good Practice Guide serves as a comprehensive framework for engineers to navigate the full lifecycle of adsorption process design—from conceptual selection of adsorbents (e.g., activated carbon, zeolites, MOFs) and equilibrium modeling (e.g., Langmuir, Freundlich isotherms) to dynamic column design, breakthrough curve prediction, regeneration strategy evaluation, and safety-integrated operational protocols. A core emphasis of the guide is on practical risk mitigation, including thermal management during exothermic adsorption, pressure drop optimization in fixed beds, and handling of hazardous or moisture-sensitive streams. It also addresses emerging challenges such as co-adsorption interference, adsorbent aging/deactivation, and integration with hybrid processes (e.g., adsorption–membrane or adsorption–distillation systems). Crucially, the guide promotes a structured, stage-gated design approach aligned with IChemE's broader process safety and sustainability principles, incorporating life-cycle assessment considerations and regulatory compliance checkpoints (e.g., EU REACH, EPA air emission standards).

Key Components

#	Component
1	Adsorbent selection criteria
2	Equilibrium isotherm modeling
3	Fixed-bed column design and scale-up

Applications

#	Application
1	Volatile organic compound (VOC) recovery from exhaust streams
2	Water purification (e.g., heavy metal or micropollutant removal)
3	Hydrogen purification and biogas upgrading (CO ₂ capture)

Related Concepts

#	Concept
1	Mass transfer operations
2	Process intensification
3	Adsorbent regeneration

Tags

adsorption, separation processes, chemical engineering design