Given positive integers $a \leq b \leq c$, let $K_{a,b,c}$ denote a complete 3-partite 3-uniform hypergraph (3-graph) with three parts of size $a, b, c$. Let $H$ be a 3-graph on $n$ vertices with $n$ divisible by $a + b + c$. We asymptotically determine the minimum vertex degree of $H$ that guarantees a perfect $K_{a,b,c}$-tiling, that is, a spanning subgraph of $H$ consists of vertex-disjoint copies of $K_{a,b,c}$. This partially answers a question of Mycroft, who proved an analogous result in terms of codegree for $k$-uniform hypergraphs for all $k \geq 3$. Our proof uses the absorbing method, the concept of fractional tiling, and a recent result on shadows for 3-graphs. (Received February 01, 2015)