CLAIMS:

1. An apparatus for alkylating an aromatic hydrocarbon reactant with an alkylating reagent comprising methanol to produce an alkylated aromatic product, comprising:

a line comprising the aromatic hydrocarbon in upstream communication with a reactor having an inner refractory lining on an inner surface of the reactor, wherein the reactor operates at a temperature in the range of 500 and a pressure in the range of 1 barg to 10 barg; and

a line in downstream communication with the reactor comprising the alkylate aromatic product, produced by reaction of the aromatic reactant and the alkylating reagent, from the reactor, wherein an entire inside lining of the reactor is coated with the inner refractory lining and the inner refractory lining comprises Fe_2O_3 passivated with phosphate.

2. The apparatus of claim 1, wherein the aromatic hydrocarbon reactant includes toluene, the alkylating reagent includes methanol, and the alkylated aromatic product includes xylene.

3. The apparatus of claim 1, wherein the aromatic hydrocarbon reactant includes benzene, the alkylating reagent includes methanol, and the alkylated aromatic product includes xylene.

4. The apparatus of claim 1, wherein the refractory comprises a mixed oxide refractory prepared using liquid phosphate as a chemical binder.

5. A process for alkylating an aromatic hydrocarbon reactant with an alkylating reagent comprising methanol to produce an alkylated aromatic product, comprising:

introducing the aromatic hydrocarbon into a reactor having an inner refractory lining on an inner surface of the reactor, wherein the reactor operates at a temperature in the range of 500 °C to 700 °C and a pressure in the range of 1 barg to 10 barg; and

recovering the alkylate aromatic product, produced by reaction of the aromatic reactant and the alkylating reagent, from the reactor, wherein an entire inside lining of the reactor is coated with the inner refractory lining and the inner refractory lining comprises Fe_2O_3 passivated with phosphate.

6. The process of claim 5, wherein the aromatic hydrocarbon reactant includes toluene, the alkylating reagent includes methanol, and the alkylated aromatic product includes xylene.

7. The process of claim 5, wherein the aromatic hydrocarbon reactant includes benzene, the alkylating reagent includes methanol, and the alkylated aromatic product includes xylene.