(B) contacting the feed with a catalyst under cleavage reaction conditions effective to produce a cleavage effluent comprising phenol and cyclohexanone, the catalyst having a collidine uptake of at least 20 μmol per gram of the catalyst and comprising (i) an aluminosilicate molecular sieve of the FAU-type; (ii) an oxide binder; and (iii) a clay.

[0010] The catalyst may comprise the molecular sieve of the FAU-type in a range from 20 wt% to 60 wt%, the oxide binder in a range from 10 wt% to 40 wt%, and the clay in a range from 5 wt% to 30 wt%, all percentages based on the total weight of the catalyst.

[0011] For example, the catalyst may comprise a FCC catalyst, such as a spent FCC catalyst.

[0012] The catalyst may meet at least one of the following requirements: (r1) comprising vanadium in a range from 0.05 wt% to 1.0 wt%, (r2) comprising nickel in a range from 0.01 wt% to 0.5 wt%, and (r3) comprising iron in a range from 0.05 wt% to 1.0 wt%, where all percentages are based on the total weight of the catalyst.

[0013] The catalyst may comprise a plurality of particles having an average size in a range from 20 μm to 200 μm. At least 50% of the plurality of the particles may be spheroidal and/or spherical, the percentages based on the total number of the particles.

[0014] ~~It is to be understood that the foregoing general description and the following detailed description are merely exemplary of the invention, and are intended to provide an overview or framework to understanding the nature and character of the invention as it is claimed.~~

BRIEF DESCRIPTION OF THE DRAWING

[0015] FIG. 1 is a diagram showing the conversion of cyclohexylbenzene hydroperoxide as a function of the quantity of feed flowing through the catalyst on a per gram basis in a cleavage reaction in the Examples of the present disclosure.

DETAILED DESCRIPTION

[0016] In the present disclosure, a process is described as comprising at least one "step." It should be understood that each step is an action or operation that may be conducted once or multiple times in the process in a continuous or discontinuous fashion. Unless specified to the contrary or the context clearly indicates otherwise, each step in a process may be conducted sequentially in the order as they are listed, with or without overlapping with one or more other step~~, or in any other order, as the case may be~~. In addition, one or more or even all steps may be conducted simultaneously with regard to the same or different batch of material. For example, in a continuous process, while a first step in a process is being conducted with respect to a raw material just fed into the beginning of the process, a second step may be

conducted simultaneously with respect to an intermediate material resulting from treating the raw materials fed into the process at an earlier time in the first step. Preferably, the steps are performed in the order listed.

[0017] ~~Unless otherwise indicated, all numbers indicating quantities in the present disclosure are to be understood as being modified by the term "about" in all instances.~~ It should also be understood that the precise numerical values used in the specification and claims constitute specific embodiments. Efforts have been made to ensure the accuracy of the data in the examples. However, it should be understood that any measured data inherently contain a certain level of error due to the limitation of the technique and equipment used for making the measurement.

[0018] As used herein, the indefinite article "a" or "an" shall mean "at least one" unless specified to the contrary or the context clearly indicates otherwise. Thus, embodiments using "a hydrogenation metal" include embodiments where one, two or more different types of the hydrogenation metals are used, unless specified to the contrary or the context clearly indicates that only one type of the hydrogenation metal is used.

[0019] As used herein, "wt%" means percentage by weight, "vol%" means percentage by volume, "mol%" means percentage by mole, "ppm" means parts per million, and "ppm wt" and "wppm" are used interchangeably to mean parts per million on a weight basis. All "ppm" as used herein are ppm by weight unless specified otherwise. All concentrations herein are expressed on the basis of the total amount of the composition in question unless specified or indicated otherwise. All ranges expressed herein should include both end points as two specific embodiments unless specified or indicated to the contrary.

[0020] The terms "group," "radical," and "substituent" are used interchangeably in the present disclosure.

[0021] As used herein, the generic term "dicyclohexylbenzene" includes, in the aggregate, 1,2-dicyclohexylbenzene, 1,3-dicyclohexylbenzene, and 1,4-dicyclohexylbenzene, unless clearly specified to mean only one or two thereof. The term "cyclohexylbenzene," when used in singular form, means mono substituted cyclohexylbenzene.

[0022] As used herein, a "FCC catalyst" is a catalyst suitable for use in a commercial petroleum fluid catalytic cracking process, a "spent FCC catalyst" is a FCC catalyst that has been exposed to the reaction conditions of a petroleum fluid catalytic cracking process, and an "equilibrium FCC catalyst" is a mixture of spent FCC catalyst and fresh FCC catalyst that has not been exposed to a petroleum fluid catalytic cracking process.

center zone of a 3/8" tubular reactor. The catalyst was first dried with flowing N_2 at 200°C and then temperature cooled down to 50°C. The CHBHP feed was fed to the reactor via an ISCO pump at a liquid pressure of 100 psig. Cleavage product was collected and analyzed by GC. The conversion for CHBHP is shown in FIG. 1 in zone 101. The catalyst deactivated with time.

[0096] To regenerate the catalyst, the reactor was first flushed with hexanes, then purged with flowing N_2 (100 cm^3/min) at 50 °C. The flowing N_2 was then switched to air (100 cm^3/min) and the temperature ramped to 550 °C. The reactor was held at 550 °C for 2 h under flowing air. The reactor was then cooled down to 50 °C, the gas turned off and the CHBHP feed was resumed (100 psig, 689 kPa, liquid pressure). The regeneration was done twice (shown as zones 103 and 105 separated by vertical dotted lines in FIG. 1); and the conversion clearly recovers after regeneration. Selectivities for the fresh and regenerated catalyst are shown in Table 2.

[0097] Similar to the slurry phase reaction, no or very little debit in cyclohexanone selectivity is seen in fixed-bed operation using spray dried experimental FCC catalyst. In addition, catalyst regenerability has been shown in this example.

Table 2

Selectivities to phenol and cyclohexanone for spray dried FCC catalyst before and after regeneration (at comparable conversions about 80-90%)

	Phenol selectivity (%)	Cyclohexanone selectivity (%)
Fresh	85.3	87.9
First regeneration	87.9	85.4
Second regeneration	81.6	80.5

[0098] ~~While the present invention has been described and illustrated by reference to particular embodiments, those of ordinary skill in the art will appreciate that the invention lends itself to variations not necessarily illustrated herein. For this reason, reference should be made solely to the appended claims for purposes of determining the true scope of the present invention.~~

[0099] Contents of all references cited herein are incorporated by reference in their entirety.

[00100] Non-limiting aspects and/or embodiments of the present disclosure include:

E1. A process for making phenol and/or cyclohexanone, the process comprising:

(A) providing a feed comprising cyclohexylbenzene hydroperoxide;

(B) contacting the feed with a catalyst under cleavage reaction conditions effective to produce a cleavage effluent comprising phenol and cyclohexanone, the catalyst having a