[31] The third major factor resides in the polymeric material component of the biocatalyst being hydrated and hydrophilic. It is believed that the microorganisms located in the interior of the biocatalyst as it is being made, especially those in the major cavities and smaller cavities, sense the hydrophilicity of the surface and this sensing of the environment also contributes to the phenotype change. The polymeric material is highly hydrated but yet contains sufficient hydrophobicity that the polymeric material in the biocatalyst is not dissolved or dispersed in water under the anticipated conditions of use. The hydrophilicity and the hydrophobicity of the polymer are such that the microorganisms become substantially irreversibly retained in the interior of the biocatalyst. As the retention of the microorganisms in the biocatalyst is due to a sensing by the microorganisms and their response, this irreversibly retention can be described as a metabolic retention. The biocatalysts can be characterized by having a Hydration Expansion Volume (HEV) of at least about 1,000, preferably at least about 5,000, and most often at least about 10,000. The Hydration Expansion Volume is indicative of the hydrophilicity of the polymeric material, and the higher the HEV, the greater is the hydrophilicity of the polymeric material.

[31a] In one aspect, there is provided a biocatalyst comprising:

a solid structure of hydrated hydrophilic polymer defining an interior structure having a plurality of interconnected major cavities having a smallest dimension of between about 5 and 100 microns and an HEV of at least about 1000 and

a population of microorganisms substantially irreversibly retained in the interior structure, said population of microorganisms being in a concentration of at least about 60 grams per liter based upon the volume defined by the exterior of the solid structure when fully hydrated,

wherein the microorganisms maintain ~~a~~ their population substantially stable.

[32] Accordingly, in one example, the biocatalyst composition of this disclosure comprises:

IT IS CLAIMED:

1. A biocatalyst comprising:

a solid structure of hydrated hydrophilic polymer defining an interior structure having a plurality of interconnected major cavities having a smallest dimension of between about 5 and 100 microns and an HEV of at least about 1000 and

a population of microorganisms substantially irreversibly retained in the interior structure, said population of microorganisms being in a concentration of at least about 60 grams per liter based upon the volume defined by the exterior of the solid structure when fully hydrated, wherein the microorganisms maintain ~~a~~ their population substantially stable.

2. The biocatalyst of claim 1 in which the HEV is at least about 5000.

3. The biocatalyst of claim 2 in which the solid structure forms an external skin.

4. The biocatalyst of claim 3 in which the skin has pores of an average diameter between about 1 and 10 microns and comprise about 1 to 30 percent of the surface area of the external skin.

5. The biocatalyst of claim 3 in which about 40 to 70 percent of the volume of the biocatalyst comprises major cavities and the biocatalyst contains smaller cavities, wherein the smaller cavities have a maximum diameter of between about 0.5 to 20 microns.

6. The biocatalyst of claim 5 in which the major cavities are quiescent.

7. The biocatalyst of claim 3 in which the HEV is at least about 20,000 and the concentration of microorganisms in the interior of the solid structure is at least about 100 grams per liter based upon the volume defined by the exterior of the solid structure.

8. The biocatalyst of claim 3 which contains an exo-network of said microorganisms.

9. The biocatalyst of claim 3 in which the microorganism population is a single strain-type.

10. The biocatalyst of claim 3 in which the microorganism population comprises bacteria or algae.

11. The biocatalyst of claim 3 in which the biocatalyst further comprises polysaccharide.

12. The biocatalyst of claim 11 in which the polysaccharide has a major dimension less than about 20 microns.