An investigation of natural nano-particles for cleaning

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ABSTRACT

Traditionally cleaning products have been produced using man made chemicals such as synthetic surfactants made of petroleum distillates, vegetable oils, or large synthetic alcohols. The chemicals used in most cleaning products can often have a negative effect on the environment. Our focus is on replacing these man made compounds with naturally occurring nano-particles which act as catalysts.

The catalysts are produced using an organic medium (sea kelp), a variety of microbes, and water. The transformation of these simple ingredients into catalysts such as enzymes and bio-surfactants is accomplished in a process that resembles the brewing of wine. This makes production relitivelly simple and inexpensive, simply put the ingredents togather, provide the right conditions, and let nature take its course.

Keywords: Catalysts, enzymes, bio-surfactants.

1 Catalysts

A catalyst decreases the activation energy of a chemical reaction. Catalysts participate in reactions but are neither reactants nor products of the reaction they catalyze. Catalysts work by providing an (alternative) mechanism involving a different transition state and lower activation energy. The effect of this is that more molecular collisions have the energy needed to reach the transition state. Hence, catalysts can perform reactions that, albeit thermodynamically feasible, would not run without the presence of a catalyst, or perform them much faster, more specific, or at lower temperatures. Catalysts *cannot* make energetically unfavorable reactions possible — they have *no* effect on the chemical equilibrium of a reaction because the rate of both the forward and the reverse reaction are equally affected. The net free energy change of a reaction is the same whether a catalyst is used or not; the catalyst just makes it easier to activate.eaction helps to accelerate the same reaction. They work by providing an alternative pathway for the reaction to occur, thus reducing the activation energy and increasing the reaction rate. Catalysts generally react with one or more reactants to form a chemical intermediate that subsequently

2 Enzymes

Enzymes are proteins that catalyze (*i.e.* accelerate) chemical reactions. In these reactions, the molecules at the beginning of the process are called substrates, and the enzyme converts them into different molecules, the products. Almost all processes in the cell need enzymes in order to occur at significant rates. Since enzymes are extremely selective for their substrates and speed up only a few reactions from among many possibilities, the set of enzymes made in a cell determines which metabolic pathways occur in that cell. Like all catalysts, enzymes work by lowering the activation energy ($\Delta G^{\ddagger}$) for a reaction, thus dramatically accelerating the rate of the reaction. Most enzyme reaction rates are millions of times faster than those of comparable uncatalyzed reactions. As with all catalysts, enzymes are not consumed by the reactions they catalyze, nor do they alter the equilibrium of these reactions. However, enzymes do differ from most other catalysts by being much more specific.

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3 Bio-Surfactants

Bio-Surfactants are a product of microbial action on an organic medium. Unlike other surfactants, bio-surfactants are effective at either end of the pH scale, and at either hot or cold temperatures. They affect the surface tension of liquids in which they are dissolved. They can lower the water's surface tension from 72 mN/m to 27 mN/m at a concentration as low as 20 μM. Bio-Surfactants accomplish this effect as they occupy the intermolecular space between water molecules, decreasing the attractive forces between adjacent water molecules, mainly hydrogen bonds, creating a more fluid solution that can go into tighter regions of space increasing water's wetting ability. Bio-Surfactants reduce the surface tension of water by adsorbing at the liquid-gas interface. They also reduce the interfacial tension between oil and water by adsorbing at the liquid-liquid interface. Many bio-surfactants can also assemble in the bulk solution into aggregates. Some of these aggregates are known as micelles. The concentration at which bio-surfactants begin to form micelles is known as the critical micelle concentration or CMC. When micelles form in water, their tails form a core that is like an oil droplet, and their (ionic/polar) heads form an outer shell that maintains favorable contact with water. When bio-surfactants assemble in oil, the aggregate is referred to as a reverse micelle. In a reverse micelle, the heads are in the core and the tails maintain favorable contact with oil.

4 Sea Kelp

We chose kelp as the basic ingredient for this product because it is a rich source of amino acids, minerals, and enzymes such as Amylase, Diastase, Phosphatase, Catalase, Cytochrome, Lactic, Oxidoreductases, Transferases, Hydrolases, Lyases, Isomerases, Pepsin, Trypsin, Thioredoxin, Peroxidase, Bromoperoxidase, Mannuronan-C5-epimerase, D-Glucanase, b-Lactamase, Penicillinase.

Analyses of kelp shows that it's mineral properties are quite different from other vegetation. Here is a breakdown:

Moisture	5.4
Protein	8.3
Dietary Fiber	37.0
Crude Fiber	3.5
Total Ash (minerals)	31.0
Ash free of salt	16.0
Fat	0.6
Salt (NaCl)	15.2

Amino Acids (% of total Amino Acids)			
Alanine	10.3	Leucine	4.9
Arginine	2.8	Lysine	4.3
Aspartic Acid	11.5	Phenylalanine	2.7
Cystine	3.0	Serine	5.0
Glycine	5.0	Threonine	6.0
Glutamic Acid	12.4	Tyrosine	3.4
Histidine	1.4	Valine	3.3
Isoleucine	2.5		

Trace minerals and elements	%
Ag Silver	0.000004
Al Aluminum	0.193000
Au Gold	0.000006

B Boron	0.019400
Ba Barium	0.001276
Be Beryllium	Trace
Bi Bismuth	Trace
Br Bromine	Trace
C Carbon	Undeclared
Ca Calcium	1.904000
Cb Niobium	Trace
Cd Cadmium	Trace
Ce Cerium	Trace
Cl Chlorine	3.680000
Co Cobalt	0.001227
Cr Chromium	Trace
Cs Cesium	Trace
Cu Copper	0.000635
F Florin	0.032650
Fe Iron	0.089560
Ga Gallium	Trace
Ge Germanium	0.000005
H Hydrogen	Undeclared
Hg Mercury	0.000190
I Iodine	0.062400
Id Indium	Trace
Ir Iridium	Trace
K Potassium	1.280000
La Lanthanum	0.000019
Li Lithium	0.000007
Mg Magnesium	0.213000
Mn Manganese	0.123500

Mo Molybdenum	0.001592
N Nitrogen	1.467000
Na Sodium	4.180000
Ni Nickel	0.003500
O Oxygen	Undeclared
Os Osmium	Trace
P Phosphorous	0.211000
Pb Lead	0.000014
Pd Palladium	Trace
Pl Platinum	Trace
Ra Radium	Trace
Rb Rubidium	0.000005
Rh Rhodium	Trace
S Sulphur	1.564200
Se Selenium	0.000043
Sb Antimony	0.000142
Si Silicon	0.164200
Sn Tin	0.000006
Sr Strontium	0.074876
Te Tellurium	Trace
Th Thorium	Trace
Ti Titanium	0.000012
Tl Thallium	0.000293
U Uranium	0.000004
V Vanadium	0.000531
W Tungsten	0.000033
Zn Zinc	0.003516
Zr Zirconium	Trace

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