Detergent compositions are formed into tablets for dispensing. These tablets can be retained in a flexible plastic bag having a rigid opening and tapered midsection. The rigidity of the tablets enables the bag to retain its shape and prevent hydratable detergents from clogging up the dispenser. A preferred detergent formulation is a high-caustic detergent composition which includes a combination of sodium tripolyphosphate and sodium tripolyphosphate hexahydrate, defoaming surfactant, polycarboxylate and a processing and dissolution aid such as propylene glycol. This detergent composition, when tableted, provides an extremely uniform dissolution rate minimizing any temperature peaks that can occur in dispensing high-caustic detergent.
| AT  | Austria  | GB  | United Kingdom |
| AU  | Australia | GE  | Georgia |
| BB  | Barbados | GN  | Guinea |
| BE  | Belgium  | GR  | Greece |
| BF  | Burkina Faso | HU  | Hungary |
| BG  | Bulgaria  | IE  | Ireland |
| BJ  | Benin   | IT  | Italy |
| BR  | Brazil  | JP  | Japan |
| BY  | Belarus  | KE  | Kenya |
| CA  | Canada  | KG  | Kyrgyzstan |
| CF  | Central African Republic | KP  | Democratic People's Republic of Korea |
| CG  | Congo  | KR  | Republic of Korea |
| CH  | Switzerland | KZ  | Kazakhstan |
| CI  | Côte d'Ivoire | LI  | Liechtenstein |
| CM  | Cameroon | LK  | Sri Lanka |
| CN  | China  | LU  | Luxembourg |
| CS  | Czechoslovakia | LV  | Latvia |
| CZ  | Czech Republic | MC  | Monaco |
| DE  | Germany  | MD  | Republic of Moldova |
| DK  | Denmark  | MG  | Madagascar |
| ES  | Spain   | ML  | Mali |
| FI  | Finland  | MN  | Mongolia |
| FR  | France  | MR  | Mauritania |
| GA  | Gabon  | MW  | Malawi |
| NE  | Niger  | NL  | Netherlands |
| NO  | Norway  | NZ  | New Zealand |
| PL  | Poland  | PT  | Portugal |
| RO  | Romania  | RU  | Russian Federation |
| SD  | Sudan  | SE  | Sweden |
| SI  | Slovenia | SK  | Slovakia |
| SN  | Senegal | TD  | Chad |
| TG  | Togo  | TJ  | Tajikistan |
| TT  | Trinidad and Tobago | UA  | Ukraine |
| US  | United States of America | UZ  | Uzbekistan |
| VN  | Viet Nam |
TABLETED DETERGENT, METHOD OF MANUFACTURE AND USE

Background of the Invention

The institutional detergent market distributes a variety of products for washing silverware, pots and pans, dishes, floors, walls, stainless steel surfaces, tile and other areas.

Unlike products used in the home, institutional detergents are often sold in bulk and dispensed from mechanical dispensers. There are a variety of different physical forms these can take, including liquids, powders, solidified bricks, granules and tablets. Several factors enter into the determination of which particular physical form is most suitable for the desired application.

Feed rate is a very important consideration. With a liquid, where the product is directly injected for use, use concentration is easy to control. Unfortunately with liquids, the concentration is generally relatively low and therefore the container size can be prohibitively large. With solid forms, which are dissolved with water, the rate of dissolution can determine feed rate.

Maintaining consistency of the product is very important. With a brick formulation, the product consistency can be maintained to a certain extent, but dissolution rate can be slow and, as with many forms, there may also be problems with disposing of the container.

Another very important factor in distributing institutional detergents is packaging. For environmental reasons, it is preferable to minimize packaging. U.S. Patent 5,078,301 discloses a bag of detergent tablets wherein the bag is a water soluble material. This product is apparently designed to minimize packaging, but has several significant disadvantages. Primarily, with a water soluble bag, the water will act to dissolve the plastic bag. However, the undissolved residue of such
bags tend to clog the dispenser. Also with a water soluble bag, there is the requirement of an exterior overwrap to prevent humidity or extraneous water from destroying the water soluble bag during shipping and storage.

All of these problems are compounded with highly hygroscopic (highly caustic) and/or hydratable materials. Of course, with the caustic materials, the operators should never physically handle the detergent. Powdered cleaning compounds are typically dispensed with water. Given that premature exposure to water tends to increase the caking tendency of powders, clogging of the dispenser and uniform dispensing from powder systems, especially those prone to prolonged periods of inactivity, may be a problem.

Another significant feature, with respect to hydratable detergents, is the mass and size of the detergent. If fully hydrated detergents are used in lieu of the anhydrous detergent, the mass and volume of the detergent will increase relative to the activity level. This, in turn, increases the shipping expenses. The dispenser also needs to be larger. Accordingly, it is preferable to use a detergent which has very little water of hydration.

Many detergents, particularly highly caustic detergents, dissolve in water and liberate a great deal of heat. It is therefore preferable to control the dissolution rate of these detergents to avoid temperature peaks in the dispensing equipment.

**Summary of the Invention**

It is an object of an aspect of the present invention to provide such a detergent which is only partially hydrated with the hydration level chosen to optimize detergent activity and processing considerations. Further, it is an object of the present invention to provide a tableted detergent contained in a flexible plastic bag which permits dispensing of the
tableted detergent by dissolution of the tablets while
contained or partially contained in the bag.

In accordance with an aspect of the invention, a
compressed tablet detergent composition comprises:
- 20% to about 70% hydratable caustic;
- from about 20% to 60% hardness sequestering agent;
- less than about 10% water of hydration; and
- 2% to 10% total liquid components
the detergent being compressed into tablets.

In accordance with a further aspect of the
invention, a dispenser for dissolving solid tableted
cleaner to provide a solution of cleaner and dispensing
such solution comprises:
- a dispenser head through which such solution is
dispensed;
- a spray means provided in the dispenser head for
  spraying water onto tableted cleaner provided in the
dispenser head;
- a flexible walled bag for such tableted cleaner and
  having an enlarged body portion and a reduced neck
  portion, the neck portion having an opening defined by a
  rim;
- a housing having a wall arrangement to encase the
  bag and support the bag in its inverted orientation with
  the bag neck directed downwardly into the dispenser head;
  the dispenser head having an opening defined by a
  shoulder where the dispenser head opening corresponds to
  the bag neck opening, the shoulder being adapted to
  support the bag neck rim with the bag supported above the
  shoulder by the housing whereby tableted cleaner falls
  through the bag neck opening, through the dispenser head
  opening and into the dispenser head;
  the dispenser head having a grid positioned below
  the dispenser head opening to support such tableted
  cleaner, the spray means being located beneath the grid
to spray water upwardly through the grid and onto such
  tableted cleaner.
These objects and advantages of the present invention will be further appreciated in light of the following detailed description and drawings in which:

**Brief Description of the Drawings**

Figure 1 is a cross-sectional view of a dispenser used according to the present invention;
Figure 2 is a perspective view of a bag designed to hold the tablets of the present invention.
Figure 3 is a graph showing temperature rise during dissolution.

**Detailed Description of the Preferred Embodiments**

The present invention is a tableted cleaner, usually a detergent, held in a collapsible or flexible plastic bag and dispensed through a spray or jet type dispenser. The tablets of the present invention can be any detergent used in the Institutional or Industrial market. These would include but not be limited to highly caustic ware washing detergents, cutlery presoaks and dishwashing detergents, floor cleaners, sanitizers, disinfectants, de-scalers, oven grill cleaners, degreasers and rinse aids. Although these vary widely in composition, they can all be utilized beneficially in the dispenser disclosed hereinafter.

The primary advantages of the present invention are appreciated in utilizing a detergent which is formed with a high percentage (i.e., in excess of 50%) of hydratable detergent components. One such particular detergent is a high caustic ware washing detergent. For use in the present invention, this ware washing detergent will include a source of caustic, a hardness sequestering system, low molecular weight water-soluble polymers, non-ionic defoaming surfactants, processing aids and optionally bleaching sources.

For use in the present invention, the caustic source can be sodium or potassium hydroxide with sodium hydroxide preferred. Generally, for use in the present invention, this will include from about 20 to about 70%
anhydrous sodium hydroxide with about 45% to about 55% anhydrous sodium hydroxide being preferred.

The hardness sequestering system can be a variety of different chemical components. These are generally selected from alkali metal salts of polyphosphates and phosphonic acid, alkali metal salts of gluconic acid, alkali metal salts of ethylene diamine tetraacetic acid, alkali metal salts of nitrilotriacetic acid and mixtures thereof.

Phosphate sequestrants are particularly useful in the present invention. These phosphates can either be hydrated or anhydrous and a mixture of anhydrous and hydrated phosphates are preferred for formulating a tablet for the present invention. The preferred anhydrous phosphate is sodium tripolyphosphate and the preferred hydrated form would be sodium tripolyphosphate hexahydrate.

Generally, the hardness sequestering system of the present invention will form 20 to about 60% of the overall mass of the detergent composition, and preferably about 35 to 40%. The preferred mixture of the anhydrous sodium tripolyphosphate and the sodium tripolyphosphate hexahydrate may be at a mass or molar ratio in the range of about 2:1 anhydrous to hexahydrate, up to essentially all of the mixture being the anhydrous component.

However, the preferred ratio is in the range of 1:1. Furthermore, the sequestering component may be entirely of the anhydrous sodium tripolyphosphate providing there is approximately 1% by weight free water in the composition.

The present invention can optionally include a chlorine source. One preferred chlorine source is dichloroisocyanurate. This is added in amounts of up to 7% by weight. Other bleaching aids include the alkali metal perborates and percarbonates.

In addition to the above, the detergent composition may include defoaming agents, typically nonionic
surfactants. The nonionic surfactant used herein is selected from the group consisting of alcoholalkoxylates, alkylealkoxylates, block copolymers and mixtures thereof. Generally, these nonionic surfactants are prepared by the condensation reaction of a suitable amount of ethylene oxide and/or propylene oxide with a selected organic hydrophobic base under suitable oxyalkylation conditions. These reactions are well known and documented in the prior art. Generally, these will have a molecular weight of 900 to about 4,000. One such surfactant is an ethylene oxide propylene oxide block copolymer. Commercially available surfactants include Triton CF32, Triton DF12, Plurefac LF131, Plurefac LF132, Plurefac LF231, Industrol N3 and Genopol PN30. These can be included in an amount from about 0.5 to about 5% with about 1.5% preferred.

In addition to this, low molecular weight (2,000-20,000), water-soluble polybasic acids such as polyacrylic acid, polymaleic or polymethacrylic acid or copolymeric acids can be used as sequestering aids, to inhibit growth of calcium carbonate crystals and to improve rinseability. Preferably the water-soluble polymer will be a polycarboxylic acid such as polyacrylic acid having a molecular weight of around 5000. Generally, the present invention should include from about 1% to about 4% polyacrylic acid on an active basis with about 2.2% preferred.

The detergent formulation should also include 1% to 5% of a polyhydric water soluble alcohol. Suitable water soluble polyhydric alcohols include propylene glycol, ethylene glycol, polyethylene glycol, glycerine, pentaerythritol, trimethylol propane, triethanolamine, tri-isopropanol amine and the like. Propylene glycol is preferred. This acts as both a processing aid and a dissolution aid for the tablet, as is discussed below.

In order to provide a strong tablet the present invention will include from about 2 to 10% liquid
components, preferably less than 8%. Generally, this can be provided for by the nonionic surfactant, the polyalcohols and/or free water. The formulation should also include 2.5% to 10% by weight of water of hydration. This also provides for a stronger tablet.

In addition to the above, the detergent formulation can include optional ingredients such as soda ash, the silicates such as sodium and potassium silicate and polysilicate, and sodium metasilicate and hydrates thereof.

A preferred formulation for use in the present invention includes the following:

**Solid Components**

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Ingredient</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.0%</td>
<td>soda ash</td>
</tr>
<tr>
<td>21.0%</td>
<td>sodium tripolyphosphate hexahydrate (18% water of hydration)</td>
</tr>
<tr>
<td>16.3%</td>
<td>sodium tripolyphosphate powder</td>
</tr>
<tr>
<td>0.2%</td>
<td>sodium dichloro-isocyanurate (ACL-60)</td>
</tr>
<tr>
<td>45.0%</td>
<td>caustic bead</td>
</tr>
</tbody>
</table>

**Liquid Components**

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Ingredient</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.5%</td>
<td>5000 molecular weight polyacrylic acid (48% active)</td>
</tr>
<tr>
<td>1.5%</td>
<td>ethylene oxide propylene oxide block copolymer</td>
</tr>
<tr>
<td>1.5%</td>
<td>non-ionic surfactant</td>
</tr>
</tbody>
</table>

In this formulation, the sodium tripolyphosphate hexahydrate provides 2.78% water of hydration and the polyacrylic acid provides about 2.3% free water.

In order to formulate the detergent of the present invention, the solid sequestrants and fillers are combined together and mixed in a ribbon or paddle blender. Thus in the preferred formula the soda ash, sodium tripolyphosphate hexahydrate, and sodium tripolyphosphate powder are combined and blended thoroughly to form a premix. Since a very low
concentration of the liquid components is being added to
the formulation, the liquid components should be combined
prior to blending with the premix. Normally, the
ethylene oxide propylene oxide block copolymer will react
with the polyacrylic acid to form a solid or gel.
However, mixing the propylene glycol with these two
liquid components prevents this reaction.

Thus, the three liquid components, polyacrylic acid
dissolved in water, the nonionic surfactant and the
propylene glycol, are thoroughly mixed together and then
sprayed evenly on the premix with mixing. Finally, the
caucistic and dichloroisocyanurate are blended with the
liquid coated premix.

It is very important that the product remain
flowable and non-tacky. Generally, this can be
accomplished by maintaining the free water at less than
5% and the total liquid at less than 10%.

The detergent blend is then pressed to form tablets
using a standard tableting machine. One such machine
suitable for use in the present invention is the Stokes
brand tableter. Generally, to form tablets, the powder
is subjected to 4 to 10 tons pressure. Generally, the
tablet will have a thickness of about 6 to 7 mm and a
diameter of about 20 mm. The maximum diameter will be a
function of the dispenser/feed water interface area. The
tablets must be able to fall down upon the dispenser
interface as disclosed hereinafter. Further, it is
preferable to have tablets with a diameter to thickness
ratio of at least about 3:1. If this tablet dimension
ratio is significantly lower, the resistance to a
tumbling style motion during transportation is too low.
This tumbling motion acts to further round the tablets,
ultimately yielding spheres. This necessarily generates
a significant quantity of fines.

As shown in Figure 1, the tablets 11 of the present
invention are placed or carried in a bag 10 for use in a
dispenser such as that shown in applicant’s own U.S.
Patent 5,147,615, or in applicant's own published
International Application WO 94/13187, the disclosures of
which are incorporated herein by reference. The optimum
shape and configuration of the bag will obviously vary
depending on the particular dispenser. The bag disclosed
herein is adapted, but not limited, to be utilized with
the preferred dispenser as described hereinafter.

The bag 10 itself is relatively simple in
construction and includes a flexible bag wall 12 having a
seam 13. The bag 10 includes an enlarged body portion
14, a tapered neck portion 15 leading to a rigid rim 16
which defines the opening 16a which is covered with a cap
18. The bag 10 also includes a pair of handle members
17a and 17b. The bag is preferably of recyclable
material, for example 10-20 mil polyethylene or
polypropylene material.

The preferred embodiment for dispenser 20, which is
a modification of applicant's aforementioned devices,
comprises a housing 21 which has an upper wall 22
designed to encase and support the bag 10 and an inner
sloped portion 23 corresponding to neck portion 15 of bag
10. This leads down to a drain section 24 of the
dispenser head generally designated 20a. The dispenser
head also includes beneath the sloped portion, a shoulder
23a for supporting the bag rim 16. The shoulder 23a
defines an opening 23b by virtue of the inner surface of
the shoulder which corresponds in shape to the opening
16a of the bag. This relationship of the openings
permits the tableted detergent to fall through the bag
opening 16a, through the support opening 23b and into a
cup 33. The cup holds the tableted product so that
tabled material remains in the bag until held-up
tabled material as needed falls down into the cup to
replace that which has been dissolved.

Water is fed to the drain portion through water
inlet 25 which is controlled by solenoid valve 27. Water
pressure can be manually adjusted with valve 28. Water
flows from the inlet 25 past the valve 27 through a conduit 29 leading to a nozzle 31.

Nozzle 31 is directed upwardly from collector 32 in the base of the housing 21. The collector itself includes, as part of the cup 33, an upper dome-shaped grid or screen 33a positioned above the spray nozzle 31. The grid 33a is provided in the bottom portion of cup 33. A drain 30 extends from the base 24a of the drain 24. There is also an overflow drain 34.

In use, the cap 18 may be removed from the rim 16 and the bag 10 is placed in the housing 21 so that the rim is resting on shoulder 23a slightly above grid 33a. If the cap 18 is of a water soluble paper or film, the bag may be placed in the dispenser with cap 18 in place. The cap is then dissolved by the water spray to release thereby the tablets down onto the grid 33a. Water controlled by solenoid valve 27 is sprayed through nozzle 31 up through the grid 33a onto tablets 11 which are resting on the grid 33a. Thus grid 33a acts as the water detergent contact zone or interface by providing a region of water spray ingress amongst tableted detergent resting on top of grid 33a. Such ingress of water ensures that the tablets continue to dissolve and do not form a lump or the like which could ultimately block off the water spray and inhibit effective dissolution of the tablets. The resulting detergent solution will then flow downwardly into the collector 32 through the drain 30 where it is directed to a ware washing machine or the like for use.

Due to the chemical composition of this formulation with the incorporation of both the hexahydrate and the anhydrous sodium tripolyphosphate, the caustic and the addition of the polyhydric alcohol, the dissolution rate of the tablets is relatively uniform providing consistent dosage until the container is virtually empty. The rate of dissolution as manifested in temperature rise is shown in Figure 3. This graph demonstrates a gradual
dissolution of the tablet with a correspondingly gradual release of caustic and resultant temperature rise.

The container itself, being a plastic bag with a rigid plastic rim, greatly facilitates dispensing the tablets and minimizes packaging. It provides both a safe package and a collapsible package, which can be recycled. Since the detergent is nondusty and noncaking, complete emptying of the bag is promoted by either gravity and/or the water spray flowing upwardly into the bag as the bag is close to being empty of tablets. This is also important for recycling as well as cost.

This bag, of course, is extremely safe, keeping the users from directly contacting the detergent. The tablets will not clog the dispenser, which can occur with some granules and plain powders, particularly hydratable detergent powders.

The particular detergent composition, in addition to providing slow, even dissolution, provides a good, well-rounded high caustic detergent composition. The method of processing the tablets provides for uniform dispersion of the liquid components within the non-liquid components and also prevents the polyacrylate from reacting with the non-ionic surfactant. In all, this is a system that provides many unique advantages.

Although preferred embodiments of the invention are described herein in detail, it will be understood by those skilled in the art that variations may be made thereto without departing from the spirit of the invention or the scope of the appended claims.
CLAIMS:
1. A compressed tablet detergent composition comprising:
   20% to about 70% hydratable caustic;
   from about 20% to 60% hardness sequestering agent;
   less than about 10% water of hydration; and
   2% to 10% total liquid components
   the detergent being compressed into tablets.

2. The compressed tablet detergent of claim 1 further comprising:
   from about 0.5% to about 5% liquid defoaming surfactant;
   from 0.5% to 5% water soluble hardness sequestering polymer; and
   from 1% to 4% water soluble liquid polyhydric alcohol.

3. The tablet of claim 1 wherein said sequestering agent is selected from the group consisting of sodium tripolyphosphate, nitrilotriacetic acid and ethylenediaminetetra-acetic acid and their common salts and hydrates.

4. The composition of claim 2 comprising 1% to 4% non-ionic surfactant and from 1% to about 4% polycarboxylic acid.

5. The composition of claim 3 comprising from about 2.5% to about 10% water of hydration.

6. A compressed tablet product comprising:
   from about 40% to about 70% caustic;
   from about 20% to about 60% of a sequestering agent
   wherein said sequestering agent is formed from the combination of sodiumtripolyphosphate and sodium tripolyphosphate hexahydrate;
from about 1% to about 4% polycarboxylic acid having a molecular weight of about 2,000 to 20,000;
from about 0.5% to about 5% of an ethylene oxide/propylene oxide copolymer; and
from about 1% to about 4% of propylene glycol;
from about 2.5% to 10% water of hydration and 2% to 6% liquid components.

7. A dispenser for dissolving solid tableted cleaner to provide a solution of cleaner and dispensing such solution, said dispenser comprising:
   a dispenser head through which such solution is dispensed;
   a spray means provided in said dispenser head for spraying water onto tableted cleaner provided in said dispenser head;
   a flexible walled bag for such tableted cleaner and having an enlarged body portion and a reduced neck portion, said neck portion having an opening defined by a rim;
   a housing having a wall arrangement to encase said bag and support said bag in its inverted orientation with said bag neck directed downwardly into said dispenser head;
   said dispenser head having an opening defined by a shoulder where said dispenser head opening corresponds to said bag neck opening, said shoulder being adapted to support said bag neck rim with said bag supported above said shoulder by said housing whereby tableted cleaner falls through said bag neck opening, through said dispenser head opening and into said dispenser head;
   said dispenser head having a grid positioned below said dispenser head opening to support such tableted cleaner, said spray means being located beneath said grid to spray water upwardly through said grid and onto such tableted cleaner.
8. The dispenser of claim 7 wherein said dispenser head has a cup extending downwardly from said shoulder to receive tableted cleaner falling out said bag, said grid being provided in a bottom portion of said cup.

9. The dispenser of claim 8 wherein said grid is dome-shaped to provide a region of water spray ingress amongst tableted cleaner on said grid.

10. The dispenser of claim 7, 8 or 9 for dispensing a tableted detergent composition of any one of claims 1 through 6.

11. The method of forming a high-caustic detergent composition comprising combining 20% to 70% solid caustic with 20% to 60% of hardness sequestering agent and fillers to form a premix; and combining an effective amount of a liquid surfactant with an effective amount of a polycarboxylic acid and a polyhydric water-soluble alcohol to form a liquid blend;

   spraying said liquid blend onto said premix;
   combining 20% to 70% caustic with said premix to form a detergent composition;
   tableting said detergent composition.

12. The method of claim 11 wherein said polyhydric alcohol is propylene glycol.

13. The method of claim 12 wherein said surfactant is an ethylene oxide/propylene oxide copolymer.