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# METHOD OF CLEANING SOILED ARTICLES

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## ABSTRACT OF THE DISCLOSURE

Cleaning soiled articles by applying a liquid to the article and subjecting the article, soil and liquid to a temperature at or below the freezing point of the liquid, thereby breaking the bond between the soil and the article by expansion of the freezing liquid.

This invention relates to a method for cleaning soiled articles and, more particularly, to a method employing refrigeration to clean soiled articles.

Although not limited in its application thereto, the present invention is particularly useful for the removal of food soil from dishes or cookware. Heretofore, the most effective method for removing food soil from dishes and cookware has been the time-honored method of subjecting the soiled articles to a solution of hot water and detergent. In addition to simple soaking of the articles some mechanical force was also employed either in the form of scrubbing with a brush, wash cloth or steel wool when articles were washed by hand or by creating a vigorous spray to impinge upon the articles when the articles were washed in an automatic dishwasher. Although both of these methods generally prove satisfactory, hand washing consumes an excessive amount of time while an automatic dishwasher sometimes fails, with its vigorous spray action, to remove tightly adhering food soils. Although hand washing will eventually remove tightly adhering food soils due to the abrasive action of wash cloths or steel wool scrubbing pads, such abrasive action frequently injures or tarnishes the article being cleaned. Accordingly, it would be desirable to provide a convenient method for removing highly adhesive food soils from dishes, cookware or other articles which will avoid injury or tarnishing of the article being cleaned.

Therefore, it is an object of this invention to provide an improved method for cleaning soiled articles.

It is another object of this invention to provide a method for cleaning soiled articles which uses refrigeration advantageously.

It is a further object of this invention to provide a method for removing highly adhesive food soils from dishes, cookware or other articles.

Further objects will become evident as the description proceeds.

Briefly stated, in accordance with one aspect of the present invention, a method is provided comprising the steps of applying water, or a liquid containing water, to at least the soiled portion of the article followed by the step of subjecting the article and liquid to a temperature at least as low as the freezing temperature of the liquid.

If desired, the article may be subsequently warmed to a desired temperature and a force may be applied to the food soil to assist in its removal from the article.

While the specification concludes with claims particularly pointing out and distinctly claiming the subject matter which is regarded as the invention, it is believed the invention will be better understood from the following description.

The adhesive bonds which are created between food soils and the substrata, the substrata being a dish, pot, pan or some other article such as, for example, an oven wall, have not been clearly identified. It is presently believed



that these adhesive bonds are predominately Van der Waal dipolar and induced dipolar bonds of the magnitude of 2 to 5 dyne centimeters resulting from the long protein, starch, carbohydrate, fat and cellulosic molecules. When food soils are severely burned onto the substrata, such as may occur when food is excessively overheated in a pot or pan or is baked onto an oven wall, primary polar bonds, in the magnitude of 60 to 75 dyne centimeters are probably present.

It should be understood, of course, that the present invention is not limited in its application to removal of food soils but may have a broader application in the removal of many types of soils from many types of substrata materials. Moreover, the exact bonds creating the adhesion between the soil and the substrata does not at present appear to be critical to performing the method of the subject invention. The foregoing discussion of Van der Waal forces is presented for whatever contribution it may provide to a clearer understanding of the present invention. The method of the present invention can be carried out without prior intensive analysis of the bonds involved.

The present invention contemplates utilizing the force provided by volumetric expansion of water as it freezes to break the aforedescribed bond. Moreover, to a lesser extent, the difference of the coefficients of thermal expansion between the substrata, i.e., pot, pan or dish, and the soil will contribute to a breaking of the aforedescribed bonds. To carry out the method of the present invention, water, or any other liquid having volumetric expansion as it changes phase to a solid, is applied to the article and the food soil and allowed to diffuse in through the microscopic interstices between the soil and the article. At present, it is believed that the small molecules of water, or other suitable liquid, diffuse through the soil and fill the gaps between the large organic molecules of the soil.

After the water has been applied, the article, food soil and water is subjected to a temperature at least as low as the freezing temperature of the liquid and are held at that temperature until the liquid freezes and expands. The expansion of the liquid breaks the bond between the soil and the substrata.

The advantages of the present method will become apparent from the following tests which removed burned-on foodstuffs generally recognized as very difficult to remove without vigorous abrasive forces being applied thereto.

Raw egg was placed in a pan and heated without presence of grease or shortening until the egg was firmly burned onto the pan. The pan was then covered with water to completely wet the egg soil. The pan, soil and water was placed into a freezer compartment of a refrigerator and remained there until the water was frozen. The pan was then removed from the freezer and allowed to stand at room temperature until the ice melted. The egg soil could be peeled from the pan in a manner similar to removing a piece of adhesive tape.

In another use of the method of the present invention, the foregoing steps were followed except that in place of allowing the pan to set at room temperatures to let the ice melt naturally, melting was accelerated by application of hot water. The result was identical to that which obtained with the natural melting of the ice.

In yet another use of the foregoing method, the melted ice, or resulting water, was poured from the pan and the soil was allowed to dry. It was discovered that the soil could be brushed off in powder form from the substrata.

Similarly, oatmeal was burned onto a pan without presence of grease or shortening and was allowed to age for one hour. Water was applied, and the pan, soil and water

were placed into a freezer until the water froze. Subsequently, the pan was removed from the freezer and allowed to melt naturally, or melting was accelerated by application of hot water, and in either case the oatmeal soil had lost all apparent adhesion and a brisk water rinse completely removed it from the substrata.

Similarly, ground beef was burned onto a pan and allowed to age for one hour at which time water was applied and the pan, water and soil were placed into a freezer until the water froze. The pan was then removed from the freezer and allowed to set until the ice melted naturally, or melting was accelerated by application of hot water, and it was discovered that the ground beef soil had lost all apparent adhesion to the substrata and had fallen from the substrata. A residual stain on the substrata was easily rubbed off with a cloth.

The foregoing experiments were conducted both with stainless steel pans and aluminum pans with no apparent difference in result. In further experiments, the use of refrigeration alone, without the application of water, appeared to render the soil more easily washable from the substrata; however, the bonds were not as completely broken as they were with the application of water. A wetting agent, an organic solution which modifies the water surface tension by a factor of three or four, was added to the water in further experiments and appeared to assist the small molecules of water to diffuse throughout the soil. In yet further experiments, superficial abrading of the soil also appeared to assist in the diffusion of the water molecules through the soil.

The foregoing description will make obvious the utility of the method of the present invention and many applications will occur to those skilled in the art. As a further example of a useful application of the present invention, its use to clean the interior surfaces of a cooking oven will be explained. For example, a suitable method for removing the food soil from the interior surface of a cooking oven would include the application of liquid to the surface either by means of a spray device, a dampened cloth or a brush. The application of the liquid would be followed by a refrigeration step which, for example, may utilize a container of compressed carbon dioxide with a nozzle to direct released carbon dioxide from the bottle onto the surface of the oven wall to thereby lower the temperature of the soil, water and oven wall to a temperature at least as low as the freezing temperature of the liquid. Subsequent steps may include that of gently brushing the wall or wiping the wall with a cloth.

Thus it can be seen that the present invention provides



a method for conveniently removing highly adhesive soils from dishes, cookware or other articles which will avoid injury or tarnishing of the article being cleaned.

As will be evident from the foregoing description, certain aspects of the invention are not limited to the particular details of the examples illustrated, and it is contemplated that various other modifications or applications will occur to those skilled in the art. It is therefore intended that the appended claims shall cover such modifications and applications as do not depart from the true spirit and scope of the invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

**1.** A method of removing soil from an article comprising the following steps:

(a) applying a liquid to at least the soiled portion of the article, and

(b) subjecting the article, soil and liquid to a temperature at least as low as the freezing temperature of the liquid.

**2.** The method of claim **1** further comprising the subsequent step of applying a force to the soil to remove it from the article.

**3.** The method of claim **2** further comprising the step of warming the article, soil and liquid to room temperature.

**4.** The method of removing soil from an article comprising the following steps:

(a) applying a liquid including water to at least the soiled portion of the article,

(b) subjecting the article to a temperature at least as low as the freezing temperature of the liquid,

(c) allowing the liquid to freeze, and

(d) applying a force to the soil to remove it from the article.

**5.** The method of claim **4** further comprising the step of warming the article, soil and liquid to room temperature prior to applying the force to the soil.

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