DESCRIPTION

TITLE OF THE INVENTION: URINE SCALE REMOVAL METHOD AND URINE SCALE DISSOLVING AGENT

TECHNICAL FIELD

[0001]

The present invention relates to a urine scale removal method and a urine scale dissolving agent capable of effectively removing urine scale accumulated in a drain pipe of a toilet or the like.

BACKGROUND ART

[0002]

In toilet drain pipes, especially drain pipes in men's toilets, cement-like urine scale accumulates through long-term use. The urine scale easily accumulates particularly in places used by many people, such as apartment buildings, schools, public facilities, and companies, and in places where cleaning is insufficient.

[0003]

The urine scale is mainly composed of a mixture of organic matters with a poorly soluble calcium-based compound produced by the decomposition of urine. The urine scale tends to accumulate in a portion remaining in contact with wastewater containing urine for a long time, and firmly adheres as a thick layer to a portion where a water pool is formed in a drain pipe. In toilet drain pipes, a portion to which urine scale is most likely to adhere is mainly a lower portion of the inner wall of a horizontal drain pipe, but urine scale can also accumulate on an upper portion of the inner wall of the horizontal drain pipe in cases where the adhesion of urine scale is heavy. In the worst case, the inside of the drain pipe is clogged with the urine scale, which makes the toilet unusable.

[0004]

The urine scale firmly adhering to the drain pipe of a toilet or the like causes foul odors and a toilet clogging, and therefore has to be removed at regular intervals. Conventionally, acidic cleaning agents containing highly toxic substances such as hydrochloric acid have been used as cleaning agents for removing urine scale. In typical urine scale removal procedures, an acidic cleaning agent is poured directly into the drain pipe of a toilet or the like, left for 15 minutes to one hour to dissolve the urine scale, and then rinsed with water. The urine scale remaining unremoved with the acidic cleaning

agent is physically crushed and removed using a high-pressure cleaning apparatus or the like.

[0005]

However, conventionally, after the acidic cleaning agent is poured into the drain pipe, the acidic cleaning agent adhering to the inner wall of the drain pipe immediately drips down and leaves a portion where the acidic cleaning agent fails to be in sufficient contact with the stain. It is difficult to keep the acidic cleaning agent adhering for a long time particularly to the upper portion of the inner wall of an S-trap or a horizontal drain pipe, making it impossible to effectively remove the urine scale.

[0006]

As a method for improving cleaning power, there has been known a method for increasing a time of contact between the acidic cleaning agent and urine scale by using a foamy cleaning agent. For example, Patent Literature 1 discloses a foam cleaning method using a cleaning apparatus capable of stably supplying a foam in a stable state where the foam is less likely to liquefy. However, since the foamy cleaning agent allows the foam to disappear and liquefy within a few tens of minutes, the foamy cleaning agent also cannot maintain the state where the agent adheres to the urine scale for a long time.

[0007]

Meanwhile, in order to increase a time of contact between an acidic cleaning agent and urine scale, there has been known a method for thickening an acidic cleaning agent by adding a thickener to the acidic cleaning agent. As a thickener of this type, polyvinyl acetate, polyacrylic acid, polyvinylacetamide, or the like is used. For example, Patent Literature 2 discloses a urine scale dissolving agent containing poly(N-vinylacetamide) as a thickener.

[0008]

However, the conventional thickeners have problems in that they are easily hydrolyzed by acids and thickeners in which hydrochloric acid is used with a high hydrochloric acid concentration, in particular, result in the viscosity decreased during a long-term storage. In the case where the hydrochloric acid concentration is lowered, the decomposition of the thickener may be suppressed but such insufficient acid concentration makes it impossible to exhibit good cleaning power.

CITATION LIST

PATENT LITERATURE

[0009]

Patent Literature 1: Japanese Patent No. 6583845

Patent Literature 2: Japanese Patent Application Publication No. 2001-64684

SUMMARY OF THE INVENTION

TECHNICAL PROBLEM

[0010]

In view of the above-mentioned conventional drawbacks, the present invention has an object to provide, based on a novel ideal, a urine scale removal method capable of effectively cleaning even urine scale adhering to a portion of a drain pipe where it is conventionally difficult to keep a urine scale dissolving agent in contact with urine scale for a long time, and a urine scale dissolving agent usable in the method.

SOLUTION TO PROBLEM

[0011]

As a result of earnest studies in view of the aforementioned object, the present inventors have found that urine scale can be effectively removed by filling a drain pipe with a urine scale remover adjusted to a predetermined viscosity and keeping the urine scale remover in direct contact with the urine scale for a long time, and therefore have come up with the present invention. More specifically, the problems of the present invention can be solved by the following configurations.

[0012]

A first aspect of the present invention is a urine scale removal method including: a urine scale dissolving agent injection step of injecting an acidic urine scale dissolving agent with a viscosity of 5000 mPa·s to 9000 mPa·s into a drain pipe to which urine scale adheres, to fill inside of the drain pipe with the urine scale dissolving agent; a urine scale dissolution step of dissolving the urine scale by keeping the urine scale dissolving agent in contact with the urine scale for at least 3 hours or longer; and a cleaning step of cleaning the drain pipe to remove the urine scale and the urine scale dissolving agent from inside the drain pipe.

[0013]

A second aspect of the present invention is the aforementioned urine scale removal method in which the urine scale dissolving agent has a pH of 1 or lower.

[0014]

A third aspect of the present invention is the aforementioned urine scale removal method in which the urine scale dissolving agent contains 15% by weight to 30% by weight of hydrochloric acid.

[0015]

A fourth aspect of the present invention is the aforementioned urine scale removal method in which the urine scale dissolving agent contains 2% by weight to 10% by weight of a quaternary ammonium salt polymer.

[0016]

A fifth aspect of the present invention is a urine scale dissolving agent which is an acidic urine scale dissolving agent with a viscosity of 5000 mPa·s to 9000 mPa·s, including: 15% by weight to 30% by weight of hydrochloric acid; and 2% by weight to 10% by weight of a quaternary ammonium salt polymer.

ADVANTAGEOUS EFFECTS OF INVENTION

[0017]

According to the first aspect of the present invention, a drain pipe of a toilet or the like to which urine scale adheres is filled with the acidic urine scale dissolving agent with a viscosity of 5000 mPa·s to 9000 mPa·s, and is left soaked with the agent for 3 hours or longer, thereby making it possible to effectively remove even urine scale adhering to a bent portion and an upper side of an inner wall of a horizontal drain pipe, where it has been difficult so fat to keep the urine scale dissolving agent in contact for a long time. Since the urine scale dissolving agent is adjusted to the appropriately high viscosity, the urine scale dissolving agent will not easily drip down. This makes it possible to increase a time of contact with urine scale and sufficiently advance the decomposition of the urine scale with the acid.

[0018]

According to the second aspect of the present invention, the urine scale dissolving agent has a pH of 1 or lower, which makes it possible to further enhance urine scale cleaning power.

[0019]

According to the third aspect of the present invention, the urine scale dissolving agent contains 15% by weight to 35% by weight of hydrochloric acid, which makes it possible to further enhance the urine scale cleaning power.

[0020]

According to the fourth aspect of the present invention, the urine scale dissolving agent contains 2% by weight to 10% by weight of a quaternary ammonium salt polymer, which makes it possible to stably maintain the viscosity for a long period of time even when the hydrochloric acid concentration is increased.

[0021]

According to the fifth aspect of the present invention, the urine scale dissolving agent contains 15% by weight to 30% by weight of hydrochloric acid as a cleaning component and 2% by weight to 10% by weight of a quaternary ammonium salt polymer as a thickening component, which makes it possible to provide a urine scale dissolving agent capable of maintaining the viscosity stably for a long period of time even when the hydrochloric acid concentration is increased.

BRIEF DESCRIPTION OF DRAWINGS

[0022]

[FIG. 1] FIG. 1 is a schematic diagram for explaining toilet bowls and a drain pipe of flush toilets to which a urine scale cleaning method of the present invention is applicable.

[FIG. 2] FIG. 2 is a schematic diagram for explaining the urine scale cleaning method of the present invention.

[FIG. 3] FIG. 3 is cross-sectional views taken along line A-A for explaining the urine scale cleaning method of the present invention.

[FIG. 4] FIG. 4 is cross-sectional views taken along line B-B for explaining the urine scale cleaning method of the present invention.

[FIG. 5] FIG. 5 is a graph showing a temperature-dependent change of a viscosity of a urine scale dissolving agent in Example 1.

DESCRIPTION OF EMBODIMENTS

[0023]

Hereinafter, a urine scale removal method and a urine scale dissolving agent of the present invention will be described in detail.

[0024]

(1) Urine Scale Removal Method

A urine scale removal method of the present invention includes: a urine scale dissolving agent injection step of injecting a high-viscosity urine scale dissolving agent into a drain pipe to which urine scale adheres; a urine scale dissolution step of dissolving the urine scale by keeping the urine scale dissolving agent in contact with the urine scale for a long time; and a cleaning step of cleaning the drain pipe with water to remove the urine scale and the urine scale dissolving agent from inside a pipe channel of the drain pipe.

[0025]

The urine scale removal method of the present invention uses an acidic urine scale dissolving agent having a viscosity of 5000 mPa·s to 9000 mPa·s. In the present invention, the urine scale dissolving agent is adjusted to the predetermined viscosity, so that the urine scale dissolving agent will not drip down easily. When the viscosity of the urine scale dissolving agent is lower than 5000 mPa·s, the urine scale dissolving agent adhering to the inner wall of the drain pipe will drip down the inner wall surface due to its own weight, and accumulate on the bottom of the drain pipe, undesirably resulting in the insufficient time of contact between the urine scale dissolving agent and the inner wall surface. The lower limit of the viscosity of the urine scale dissolving agent is preferably 5500 mPa·s or higher and particularly preferably 6000 mPa·s or higher.

[0026]

On the other hand, when the viscosity of the urine scale dissolving agent exceeds 9000 mPa·s, the load required to inject the urine scale dissolving agent becomes so high that the workability of injection is worsened. In addition, air trapped in the urine scale dissolving agent may be sent together with the urine scale dissolving agent, and creates air pockets where urine scale may remain. Moreover, such high viscosity is also undesirable in that the work for washing away the urine scale dissolving agent in the subsequent cleaning step requires a long time. The upper limit of the viscosity of the urine scale dissolving agent is preferably 8500 mPa·s or lower and particularly preferably 8000 mPa·s or lower.

[0027]

The urine scale dissolving agent is acidic, preferably with a pH of 3 or lower. From the viewpoint of a cleaning effect against urine scale, it is more preferable that the urine scale dissolving agent be strongly acidic with a pH of 1 or lower.

[0028]

(Urine Scale Dissolving Agent Injection Step)

The urine scale dissolving agent injection step will be described. A target to be cleaned is not particularly limited, as long as the target has a drain pipe connected to a flush toilet bowl, a bathtub, or the like. The following description will be given by using flush toilets as an example.

[0029]

FIG. 1 is a schematic diagram for explaining toilet bowls and a drain pipe of flush toilets to which the cleaning method of the present invention is applicable. A toilet bowl 10 is a known men's urinal, and multiple toilet bowls 10 are installed side by side. Each toilet bowl 10 includes a bowl portion 12 provided with a drain port 11. In addition, a drain pipe 13 includes a trap portion 13A, a horizontal drain pipe 13B, and a cleaning port 13C.

[0030]

The trap portion 13A, which is continuously connected to the drain port 11 of the toilet bowl 10, seals off odors generated from the drain pipe 13 with a water pool W1 inside the trap portion 13A.

[0031]

The downstream side of each trap portion 13A communicates with the horizontal drain pipe 13B. After use of the flush toilet, wastewater flows from the drain port 11 of the toilet bowl 10 through the inside of the trap portion 13A and the horizontal drain pipe 13B into a vertical pipe 14. However, some of the wastewater remains in the horizontal drain pipe 13B, and forms a water pool W2 on a lower side of the inner wall of the horizontal drain pipe 13B.

[0032]

In the drain pipe 13, portions to which urine scale tends to adhere are portions having the water pools W1 and W2 where the wastewater containing urine stays. In particular, urine scale tends to accumulate in the water pool W2 on the lower side of the inner wall of the horizontal drain pipe 13B. The cleaning port 13C is provided on the

upstream side of the horizontal drain pipe 13B. When a clogging occurs in the drain pipe 13, the drain pipe 13 can be inspected and cleaned from the cleaning port 13C.

[0033]

In the urine scale dissolving agent injection step, as shown in FIG. 2, a urine scale dissolving agent C is injected into the drain pipe 13 from the drain ports 11 of the toilet bowls 10 and the cleaning port 13C. Since the urine scale dissolving agent C is a viscous fluid and therefore requires a high injection load, it is preferable to use a manual or electric pump for injecting the urine scale dissolving agent C.

[0034]

The urine scale dissolving agent C, injected by the pump, enters the horizontal drain pipe 13B while flushing away the water accumulated in the trap portion 13A. Since the urine scale dissolving agent C is the viscous fluid, if an appropriate amount of the urine scale dissolving agent C is injected from the drain ports 11 of the toilet bowls 10 and the cleaning port 13C, the inside of a pipe channel of the drain pipe 13 is filled with the urine scale dissolving agent C, resulting in a state where there are virtually no air voids as shown in FIG. 2. The amount of the urine scale dissolving agent C injected varies depending on the length and diameter of the drain pipe 13, but is generally about 2 to 4 liters per toilet bowl 10. The cleaning method of the present invention is economical because the use of a high-viscosity urine scale dissolving agent makes it possible to exhibit a sufficient cleaning effect without using a large amount of a urine scale cleaning agent.

[0035]

(Urine Scale Dissolution Step)

In the urine scale dissolution step, after the inside of the drain pipe 13 is filled with the high-viscosity urine scale dissolving agent C, the filled urine scale dissolving agent C is left for a long time to dissolve the urine scale adhering to the inner wall of the drain pipe 13. In this step, the urine scale adhering to the inner wall of the drain pipe 13 is gradually decomposed by the acid in the urine scale dissolving agent C. Since the urine scale dissolving agent C is adjusted to the appropriately high viscosity, the urine scale dissolving agent C will not easily drip down. This makes it possible to increase a time of contact with urine scale and sufficiently advance the decomposition of the urine scale with the acid.

[0036]

FIG. 3 shows cross-sectional views of a vertical pipe section 13A' of the trap portion 13A taken along line A-A, and FIG. 4 shows cross-sectional views of the horizontal drain pipe 13B taken along line B-B. Immediately after the application, the inside of the trap portion 13A and the inside of the horizontal drain pipe 13B are completely filled with the urine scale dissolving agent C, but over time, the urine scale dissolving agent C drips down the inner wall of the drain pipe 13 at a very slow speed.

[0037]

As shown in FIG. 3, in the vertical pipe section 13A', the urine scale dissolving agent C drips down from the upper side to the lower side at a slow speed, and thus gradually creates an air void from the upper side. Meanwhile, as shown in FIG. 4, in the horizontal drain pipe 13B, an air void is gradually widened from the center of the pipe over time. However, in the present invention, since the urine scale dissolving agent C is adjusted to the predetermined viscosity, the state in which the urine scale dissolving agent C adheres to the inner wall of the drain pipe 13 is maintained. Although depending on conditions such as viscosity and climate, the state in which the inner wall of the drain pipe 13 is completely covered with the urine scale dissolving agent C can be maintained even after the passage of 12 hours. Therefore, it is possible to effectively remove even urine scale U adhering to the upper side of the vertical pipe section 13A' of the trap portion 13A and the upper side of the inner wall of the horizontal drain pipe 13B, where it has been difficult so far to keep the urine scale dissolving agent in contact with the urine scale U for a long time.

[0038]

In the urine scale dissolution step, the urine scale dissolving agent C is left in direct contact with the urine scale U adhering to the drain pipe 13 for at least 3 hours or longer, preferably 6 hours or longer, and more preferably 8 hours or longer. Depending on the hardness and thickness of urine scale U to be cleaned, the urine scale U will be almost completely dissolved when left in contact with the urine scale dissolving agent C with a pH of 1 or lower for 8 hours.

[0039]

(Cleaning step)

At last, the urine scale dissolving agent C, the dissolved urine scale components, detached urine scale fragments, and so on are sufficiently washed away with running water, so that the drain pipe 13 can be thoroughly cleaned.

[0040]

In the cleaning step, it is preferable to clean the drain pipe 13 by cleaning with high pressure. The urine scale U remaining undissolved in the urine scale dissolution step is also made brittle due to contact with the urine scale dissolving agent C for a long time, and is easily crushed into fine particles and washed away by cleaning with high pressure. At this time, a urine scale crushing apparatus using a high-speed rotating chain or the like may be inserted from the cleaning port 13C to crush the urine scale U remaining on the inner wall of the drain pipe 13.

[0041]

(2) Urine Scale Dissolving Agent

Next, a composition and a preparation method of a urine scale dissolving agent used in the urine scale cleaning method of the present invention will be described. The urine scale dissolving agent is a high-viscosity acidic cleaning agent and is a viscous fluid containing an acid as a cleaning component and a thickener. The urine scale dissolving agent is prepared by preparing an acidic aqueous solution containing an acid as a cleaning component, and then adding a thickener to this acidic aqueous solution to impart viscosity.

[0042]

(Acidic Aqueous Solution)

The acidic aqueous solution is a solution in which the acid used as the cleaning agent is diluted with water or a solvent primarily composed of water. The solvent may contain a water-miscible organic solvent such as alcohol.

[0043]

As the acid as the cleaning agent, either an inorganic acid or an organic acid may be used. As the inorganic acid, an inorganic acid such as hydrochloric acid, sulfuric acid, boric acid, phosphoric acid, or nitric acid may be used. As the organic acid, an organic acid such as formic acid, acetic acid, succinic acid, malonic acid, oxalic acid, malic acid, citric acid, lactic acid, phosphonic acid, p-toluenesulfonic acid, or ascorbic acid may be used. In addition, two or more of these acids may be used in combination.

[0044]

Among these acids, it is preferable to use an inorganic acid with a high degree of ionization, and it is particularly preferable to use hydrochloric acid from the viewpoint of the cleaning power.

[0045]

(Thickener)

A thickener is not particularly limited as long as it can impart predetermined viscosity to an acidic aqueous solution and any known thickener may be used. It is preferable to use a thickener containing a cationic polymer as a thickening component.

[0046]

Examples of the cationic polymer include quaternary ammonium salt polymers, quaternized polyvinylpyrrolidone derivatives, vinylimidazolium trichloride/vinylpyrrolidone copolymers, hydroxyethylcellulose/dimethyldiallylammonium chloride copolymers, vinylpyrrolidone/quaternized dimethylaminoethyl methacrylate copolymers, polyvinylpyrrolidone/alkylaminoacrylate copolymers, polyvinylpyrrolidone/alkylaminoacrylate/vinylcaprolactam copolymers, vinylpyrrolidone/methacrylamidopropyl trimethylammonium chloride copolymers, alkylacrylamide/acrylate/alkylaminoalkylacrylamide/polyethylene glycol methacrylate copolymers, adipic acid/dimethylaminohydroxypropylethylenetriamine copolymers, cationized cellulose derivatives, cationic starch, cationized guar gum derivatives, and so on. Two or more of these cationic polymers may be used in combination.

[0047]

Among these cationic polymers, it is particularly preferable to use a quaternary ammonium salt polymer. A quaternary ammonium salt polymer can retain a stable thickening effect in an acidic region and is stable because it is hardly decomposed by hydrochloric acid. In the case where a quaternary ammonium salt polymer is used as a thickening component, a urine scale dissolving agent adjusted to a hydrochloric acid concentration corresponding to a pH of 1 or lower can keep its viscosity with almost no decrease, even after the urine scale dissolving agent is stored for several months.

[0048]

The quaternary ammonium salt polymer is a polymer obtained by polymerizing a quaternary ammonium salt. As the quaternary ammonium salt, there are N,N-

dimethyldiallylammonium chloride, N,N-diethyldiallylammonium chloride, N,N-ethylmethyldiallylammonium chloride, N,N-dimethyldiallylammonium bromide, acryloyloxyethyltrimethylammonium chloride, acryloyloxyethyltriethylammonium chloride, methacryloyloxyethyltrimethylammonium chloride, methacryloyloxyethyltriethylammonium chloride, acryloylaminoethyltrimethylammonium chloride, acryloylaminoethyltriethylammonium chloride, methacryloylaminoethyltrimethylammonium chloride, methacryloylaminoethyltriethylammonium chloride, methyl chloride quaternized products or ethyl chloride quaternized products of vinylpyridine, methyl chloride quaternized products or ethyl chloride quaternized products of allylamine, vinylbenzyltrimethylammonium chloride, vinylbenzyltriethylammonium chloride, vinylbenzyltributylammonium chloride, acryloyloxyethylbenzyldimethylammonium chloride, acryloyloxyethylbenzyldiethylammonium chloride, methacryloyloxyethylbenzyldimethylammonium chloride, methacryloyloxyethylbenzyldiethylammonium chloride, acryloylaminoethylbenzyldimethylammonium chloride, acryloylaminoethylbenzyldiethylammonium chloride, methacryloylaminoethylbenzyldimethylammonium chloride, methacryloylaminoethylbenzyldiethylammonium chloride, and so on. Two or more of these quaternary ammonium salts may be used in combination and polymerized. Among these quaternary ammonium salts, it is particularly preferable to use N,N-dimethyldiallylammonium chloride.

[0049]

Moreover, it is also possible to use, as the quaternary ammonium salt polymer, a copolymer obtained by copolymerizing a quaternary ammonium salt with another compound copolymerizable with it. As the compound copolymerizable with a quaternary ammonium salt, for example, (meth)acrylamide, N-vinylformamide, methyl(meth)acrylate, 2-hydroxy(meth)acrylamide, or the like may be applied. In the case of a copolymer, the copolymer preferably uses at least one selected from the aforementioned quaternary ammonium salts in an amount of 30 mol% or more, and more preferably uses it in an amount of 50 mol% or more.

[0050]

The viscosity of an aqueous solution containing 2% by weight of a quaternary ammonium salt polymer ranges from 1,000 mPa·s to 50,000 mPa·s, with a preferred aqueous solution viscosity being 3,000 mPa·s to 30,000 mPa·s.

[0051]

In the case where a quaternary ammonium salt polymer is used, it is possible to add the powdered quaternary ammonium salt polymer to a prepared hydrochloric acid aqueous solution, but it is preferable to add a water-in-oil emulsion containing the quaternary ammonium salt polymer. By use of a water-in-oil emulsion thickener, when added to the acidic aqueous solution, the thickener is less likely to form agglomerates and allows the thickening component (quaternary ammonium salt polymer) to be uniformly dispersed by stirring for a short time. The water-in-oil emulsion containing the quaternary ammonium salt polymer may be obtained by a known method.

[0052]

As the water-in-oil emulsion thickener containing the quaternary ammonium salt polymer, for example, a commercially available product such as SENKA ACTGEL CD100 or SENKA ACTGEL CM100 (SENKA corporation) may be used.

[0053]

(Preparation Method)

Next, a method for preparing a urine scale dissolving agent will be described. With the thickener added to the acidic aqueous solution, the viscosity during application is adjusted to a range of 5,000 mPa·s to 9,000 mPa·s. Needless to say, the viscosity of the urine scale dissolving agent can be adjusted mainly by the type and content of the thickener. The viscosity of the urine scale dissolving agent tends to increase in winter when the atmospheric temperature is low and decrease in summer when the atmospheric temperature is high. In order to ensure the viscosity suitable for application work throughout the year, the viscosity of the urine scale dissolving agent is preferably in the range of 5000 mPa·s to 9000 mPa·s at 5℃ to 30℃.

[0054]

The urine scale dissolving agent of the present invention contains almost no air bubbles. After the thickener is added to the acidic aqueous solution, the resultant mixture is stirred gently so as to reduce incorporation of air bubbles to the minimum possible extent. Although a case where a urine scale dissolving agent used in the present

invention is creamy and contains a small amount of air bubbles is not excluded, the specific gravity of the urine scale dissolving agent is adjusted to a range of 1.00 to 1.18.

[0055]

The composition of a particularly preferred urine scale dissolving agent of the present invention is as follows.

Hydrochloric acid: 5% by weight to 30% by weight

Quaternary ammonium salt polymer: 2% by weight to 10% by weight

Other components: 0% by weight to 10% by weight

Water: balance

[0056]

When the hydrochloric acid concentration in the urine scale dissolving agent is less than 5% by weight, the urine scale dissolving agent may fail to exhibit the cleaning effect sufficiently. In order to dissolve the urine scale and the like within a short time, the hydrochloric acid concentration in the urine scale dissolving agent is preferably adjusted to 15% by weight or more and 30% by weight or less. When the hydrochloric acid concentration exceeds 30% by weight, the urine scale dissolving agent may generate toxic gases such as hydrochloric acid gas and therefore be difficult to handle.

[0057]

When the concentration of the quaternary ammonium salt polymer in the urine scale dissolving agent is less than 2% by weight, the sufficient viscosity cannot be imparted to the urine scale dissolving agent. Meanwhile, the concentration of the quaternary ammonium salt polymer in the urine scale dissolving agent is preferably 10% by weight or less, more preferably 4% by weight or more and 8% by weight or less, and particularly preferably 5% by weight or more and 7% by weight or less.

[0058]

In addition to the aforementioned components, the urine scale dissolving agent may contain other components to improve the cleaning performance, dispersibility, and stability, as long as the urine scale dissolving agent will not depart from the object of the present invention. The other components include an additive such as a surfactant, an organic dispersion medium contained in the thickener, and so on. The concentration of the other components in the urine scale dissolving agent is 10% by weight or less and preferably 5% by weight or less.

[0059]

The urine scale dissolving agent with the above composition hardly decreases in viscosity due to hydrochloric acid. Therefore, even after being stored over a long period of time, the urine scale dissolving agent can maintain almost the same quality as immediately after production. Thus, the urine scale dissolving agent is suitably usable in the urine scale cleaning method of the present invention.

Examples

[0060]

The present invention will be described in further detail by using following Examples, but the present invention is not limited to these Examples. Note that in Examples, the viscosity was measured by using a BM-type rotational viscometer.

[0061]

(Example 1)

First, a urine scale dissolving agent was prepared. As the thickener, SENKA ACTGEL CD100 (Senka Corporation), that is, a water-in-oil emulsion containing 40% by weight of a quaternary ammonium salt polymer, was used.

[0062]

A urine scale dissolving agent containing 25% by weight of hydrochloric acid and 4% by weight of a quaternary ammonium salt polymer was prepared by adding SENKA ACTGEL CD100 while stirring an aqueous hydrochloric acid solution. The urine scale dissolving agent had a pH of 1 or lower, a viscosity at 25℃ of 6500 mPa·s, and a specific gravity of 1.03.

[0063]

FIG. 5 shows a temperature-dependent change of the viscosity of the urine scale dissolving agent in Example 1. Although the viscosity of a urine scale dissolving agent tends to increase in winter when the atmospheric temperature is low and decrease in summer when the atmospheric temperature is high, the urine scale dissolving agent in Example 1 maintained the viscosity in the range of 5000 mPa·s to 9000 mPa·s at 5℃ to 30℃, which indicates that the urine scale dissolving agent can ensure the viscosity suitable for application work throughout the year.

[0064]

Next, the urine scale dissolving agent in Example 1 was used to perform work of removing urine scale from urinals in an office building. Before application, the inside of the drain pipe was photographed from the cleaning port by a camera to check the state of urine scale adhering to the horizontal drain pipe and to calculate an amount of the urine scale dissolving agent required for filling the inside of the drain pipe.

[0065]

Using a manual pump, the appropriate amount of the urine scale dissolving agent was injected from the drain ports of the urinals and the cleaning port, and thereby the inside of the drain pipe was completely filled with the urine scale dissolving agent. After being left in this state for 10 hours, the inside of the drain pipe was cleaned with high pressure. After the cleaning, the inside of the drain pipe was photographed again from the cleaning port by the camera and it was confirmed that the thick urine scale that had adhered to the inside of the drain pipe was all removed and thoroughly cleaned away.

[0066]

Next, the viscosity and pH stabilities of the urine scale dissolving agent in Example 1 were measured. The viscosity of the urine scale dissolving agent in Example 1 was measured every month while the urine scale dissolving agent was left at room temperature. It was confirmed that, even after 6 months of storage, the urine scale dissolving agent in Example 1 maintained almost the same viscosity as immediately after production. Furthermore, the pH of 1 or lower was maintained even after 6 months, and it was confirmed that the urine scale dissolving agent in Example 1 had the sufficient stabilities.

[0067]

(Example 2)

A urine scale dissolving agent containing 17% by weight of hydrochloric acid and 4% by weight of the quaternary ammonium salt polymer was prepared in the same method as in Example 1. The urine scale dissolving agent had a pH of 1 or lower, a viscosity at 25℃ of 7000 mPa·s, and a specific gravity of 1.01.

[0068]

In the same manner as in Example 1, the work of removing urine scale from urinals in the office building was performed. Before and after the cleaning, the inside of the drain pipe was photographed by the camera and it was confirmed that the urine

scale dissolving agent in Example 2 thoroughly cleaned away the urine scale that had adhered to the inside of the drain pipe.

[0069]

(Example 3)

An aqueous solution containing 10% by weight of poly(N-vinylacetamide) "GE-191" (manufactured by Showa Denko Corporation) was prepared, and this aqueous solution was used as a thickener.

[0070]

The aqueous solution containing 10% by weight of poly(N-vinylacetamide) was added to a hydrochloric acid aqueous solution while stirring, thereby preparing a urine scale dissolving agent containing 25% by weight of hydrochloric acid and 5% by weight of the poly(N-vinylacetamide). The urine scale dissolving agent had a pH of 1 or lower, a viscosity at 25℃ of 6000 mPa·s, and a specific gravity of 1.03.

[0071]

Next, in the same manner as in Example 1, the urine scale dissolving agent in Example 3 was used to perform the work of removing urine scale from urinals in the office building. The appropriate amount of the urine scale dissolving agent was injected and thereby the inside of the drain pipe was filled with the urine scale dissolving agent. After being left in this state for 10 hours, the inside of the drain pipe was cleaned with high pressure. After the cleaning, the inside of the drain pipe was photographed by the camera and it was confirmed that the urine scale that had adhered to the inside of the drain pipe was thoroughly cleaned away.

[0072]

Next, the viscosity and pH stabilities of the urine scale dissolving agent in Example 3 were measured. The viscosity and pH of the urine scale dissolving agent in Example 3 were measured approximately every month while the urine scale dissolving agent was left at room temperature. The viscosity immediately after production was 6000 mPa·s, but the viscosity decreased from one month onward and decreased to 2000 mPa·s after six months. Meanwhile, the pH gradually increased from one month onward and changed to a pH 2 after six months.

[0073]

These results indicate that the urine scale dissolving agent in Example 3 is a urine scale dissolving agent that has the sufficient cleaning power immediately after production but is not suitable for long-term storage. During long-term storage, the thickening component decomposes to decrease the viscosity and increase the pH, which deteriorates the cleaning performance. Therefore, the urine scale dissolving agent should be used up within one month after production.

[0074]

(Comparative Example 1)

A urine scale dissolving agent containing 25% by weight of hydrochloric acid and 12% by weight of the quaternary ammonium salt polymer was prepared in the same method as in Example 1. The urine scale dissolving agent had a pH of 1 or lower, a viscosity at 25℃ of 12000 mPa·s, and a specific gravity of 1.03.

[0075]

In the same manner as in Example 1, the work of removing urine scale from urinals in the office building was performed. After the cleaning, the inside of the drain pipe was photographed by the camera and the urine scale was observed remaining partially adhering. In particular, it was confirmed that the urine scale still adhered to bent portions in the drain pipe and connection portions between differently-shaped drain pipes. This is presumably because the viscosity of the urine scale dissolving agent in Comparative Example 1 was too high to fully fill the entire drain pipe with the urine scale dissolving agent.

[0076]

(Comparative Example 2)

A urine scale dissolving agent containing 25% by weight of hydrochloric acid and 1.5% by weight of the quaternary ammonium salt polymer was prepared in the same method as in Example 1. The urine scale dissolving agent had a pH of 1 or lower, a viscosity at 25℃ of 4000 mPa·s, and a specific gravity of 1.03.

[0077]

In the same manner as in Example 1, the work of removing urine scale from urinals in the office building was performed. After the cleaning, the inside of the drain pipe was photographed by the camera and urine scale was observed remaining partially adhering. In particular, the urine scale remained adhering to the upper side of the inner

wall of the horizontal drain pipe. This is presumably because the viscosity of the urine scale dissolving agent in Comparative Example 2 was so low that the agent dripped down and generated portions where the time of contact with the urine scale dissolving agent was insufficient.

[0078]

[Table 1]

Example No.	Thickening Component	Hydrochloric Acid Concentration	Viscosity (mPa·s)	Cleaning Performance	Stability
Example 1	Quaternary Ammonium Salt Polymer	25 wt%	6500	○	○
Example 2	Quaternary Ammonium Salt Polymer	17 wt%	7000	○	○
Example 3	Poly(N-Vinylacetamide)	25 wt%	6000	○	×
Comparative Example 1	Quaternary Ammonium Salt Polymer	25 wt%	12000	△	○
Comparative Example 2	Quaternary Ammonium Salt Polymer	25 wt%	4000	×	○

Industrial Applicability

[0079]

As described above, the urine scale removal method of the present invention includes injecting an acidic urine scale dissolving agent, adjusted to an appropriately high viscosity, into a drain pipe of a toilet or the like to which urine scale adheres, and leaving the drain pipe soaked with the agent for a long time, thereby making it possible to effectively remove even the urine scale adhering to bent portions and an upper surface of a horizontal drain pipe, which have been difficult so fat to keep in contact with the urine scale dissolving agent for a long time.

[0080]

Moreover, the urine scale dissolving agent of the present invention hardly decreases in viscosity due to hydrochloric acid, and therefore can maintain almost the same quality as immediately after production, even after being stored over a long period of time. Thus, the urine scale dissolving agent can be used in the urine scale cleaning method of the present invention.

[0081]

The urine scale removal method and the urine scale dissolving agent of the present invention may be used not only for toilet drain pipes, but also for bathtub drain

pipes, livestock drain pipes where urine scale adheres due to animal waste, and other pipes, and may be used in various fields where urine scale cleaning is required.

REFERENCE SIGNS LIST

[0082]

10	toilet bowl
11	drain port
12	bowl portion
13	drain pipe
13A	trap portion
13A'	vertical pipe section
13B	horizontal drain pipe
13C	cleaning port
W1, W2	water pool
C	urine scale dissolving agent
U	urine scale

CLAIMS

[Claim 1] A urine scale removal method comprising:

a urine scale dissolving agent injection step of injecting an acidic urine scale dissolving agent with a viscosity of 5000 mPa·s to 9000 mPa·s into a drain pipe to which urine scale adheres, to fill inside of the drain pipe with the urine scale dissolving agent;

a urine scale dissolution step of dissolving the urine scale by keeping the urine scale dissolving agent in contact with the urine scale for at least 3 hours or longer; and

a cleaning step of cleaning the drain pipe to remove the urine scale and the urine scale dissolving agent from inside the drain pipe.

[Claim 2] The urine scale removal method according to claim 1, wherein the urine scale dissolving agent has a pH of 1 or lower.

[Claim 3] The urine scale removal method according to claim 1, wherein the urine scale dissolving agent contains 15% by weight to 30% by weight of hydrochloric acid.

[Claim 4] The urine scale removal method according to claim 1, wherein the urine scale dissolving agent contains 2% by weight to 10% by weight of a quaternary ammonium salt polymer.

[Claim 5] A urine scale dissolving agent which is an acidic urine scale dissolving agent with a viscosity of 5000 mPa·s to 9000 mPa·s, comprising:

15% by weight to 30% by weight of hydrochloric acid; and

2% by weight to 10% by weight of a quaternary ammonium salt polymer.