

CART WASHER

[0001] The present application relates to a cart washer. The application also relates methods of making, assembling, disassembling, installing, configuring, maintaining
5 and using the cart washer.

[0002] In airline catering services, carts that carry food and beverage boxes, cups or trays often reused and require regular cleaning. A cart is sometimes known as an airline trolley catering cart, an airline aircraft catering cart, an airline cart, an aircraft
10 inflight service meal cart, a food catering cart or an aircraft inflight service meal cart when used in airline catering business. Due to frequent flights services in modern days, airline operators desire fast turnover of their carts so that the airline operators can keep less stock of the carts and provide a smaller storage space for cart turnover. In cart handling, cart cleaning is an important procedure for maintaining hygiene
15 quality of airline catering services. However, the cart cleaning is also time consuming, tedious and laborious. Particularly, since manual cart washing technique is predominantly deployed worldwide, workers of airline catering centres often face health and safety hazards when washing the carts in wet and oily environment continuously.

[0003] The present invention aims to provide a new and useful cart washer. The present invention also aims to provide new and useful methods of making, assembling, disassembling, installing, configuring, maintaining and using the cart washer. Essential features of the inventions are provided by the independent claims,
25 whilst advantageous features of the inventions are given by the dependent claims. The present application claims priority of Singapore patent application 2014000319 with the same title of Cart Washer, which was filed on 03 January 2014. All content of this earlier application is hereby incorporated by reference.

[0004] According to a first aspect, the present application provides a cart washer that comprises a detergent station for cleaning one or more soiled carts with detergent. The cart is also known as meal servicing cart or trolley for inflight catering or dining. The cart washer further comprises a sanitizing station that is connected to the detergent station for disinfecting the one or more soiled carts with sanitizing agent.

The cart washer additionally comprises a prewash station which is connected to the detergent station or the sanitizing station for deactivating the detergent, the sanitizing agent or both the detergent and the sanitizing agent.

- 5 [0005] The neutralisation (i.e. neutralization) station is configured to deactivate, dilute, degrade, decompose or reduce potency of the detergent (i.e. cleaning agent), the sanitizing agent (i.e. sterilising agent) or both the cleaning agent and the sterilising agent by and/or at the neutralisation station. Here, the cleaning agent is also known as detergent which is a surfactant or a mixture of surfactants with "cleaning properties"
- 10 in dilute solutions. The cleaning agent includes any of a group of synthetic, organic, liquid or water-soluble cleaning agents that are not prepared from fats and oils, are not inactivated by hard water, and have wetting-agent as well as emulsifying-agent properties. The cleaning agent (i.e. cleansing agent) or detergent is oil-soluble and capable of holding insoluble foreign matter in suspension, sometimes used in
- 15 lubricating oils, dry-cleaning preparations, etc., including soap. The sterilising agent comprises antiseptics (e.g. bacteriocidal and bacteriostatic), antibacterial material(s) (e.g. microbicides) and disinfectants that can destroy or inhibit growth of bacteria, germs or fungus. Alternatively, the sterilising agent may merely comprises clean water alone or in combination with other fluid(s) for rinsing off detergent residue. In
- 20 the neutralisation, for example, the neutralisation station causes decomposition of a non-ionic detergent Symperonic NP10 by the Fenton method in the presence of iron nanocompounds.

- [0006] Although the cleaning agent and the sterilising agent are effective for carts,
- 25 used or depleted cleaning agent and the sterilising agent are often harmful to environment if discharged directly to drains. For example, the discharge of soluble phosphates into natural waters has led to problems with eutrophication, or the growth of living things in lakes and streams, where it is not desirable usually. Australia began phasing out the use of phosphates in its detergents in year 2011, with an all-out ban
- 30 expected to take effect in year 2014. In the present cart washer, the neutralisation can station collect the cleansing/cleaning agent, the sterilising agent or both for their decomposition, degradation or dilution such that discharged washing fluid(s) from the neutralisation station or other stations become(s) more environmentally friendly. For example, aquatic fungi, aquatic bacterial flora, bacillus, bacillus cereus or other

species of bacteria can be deposited at the neutralisation station regularly, intermittently, periodically or continuously for degrading or decomposing household detergents (surfactants) effectively. Therefore, the present cart washer is accordingly known as Green Cart Washer or Environmental Friendly Cart washer. Alternatively, washing liquids from the detergent station or the sanitizing station are added with additional liquid(s) (e.g. salty or fresh water) or used liquid(s) (e.g. dirty water) such that waste water of cart washer is treated by or discharged from or by the neutralisation station, which possesses less potency for damaging the environment. Alternatively speaking, the neutralisation station causes used cleansing/cleaning agent, the sterilising agent or both to be more chemically neutral, such as closer to pH7.0 (e.g. about pH6.2 to 8.0 or narrower/closer to pH7.0), before discharging to environment (e.g. drainage or system of drains).

[0007] The cart washer can further comprise a conveyor (i.e. transporter) that is connected to the detergent station, the sanitizing station, the prewash station or a combination of any of these stations for transporting the soiled cart for washing. The conveyor provide convenience to move the soiled cart from one washing station to the other without human interference. Accordingly, the cart washer can wash soiled carts automatically, under the control of PLC (Programmable Logic Controller), microcontroller(s) or other computer(s). Particularly, the conveyor can include chains, jigs or locks for securing the soiled cart onto the conveyor during washing process.

[0008] The cart washer may further comprise a detergent tank that is connected to the detergent station for delivering the detergent. The cart washer may additionally comprises a sanitizing tank that is connected to the sanitizing station for supplying the sanitizing agent. Detergent and sanitizing agent may be separated and used sequentially for washing soiled carts. More effectively, a soiled cart is cleaned by the detergent at the detergent washing station, and subsequently washed at the sanitizing agent at the sanitizing station. Fluid level or rate of fluid supply can be individually monitored and controlled for delivering suitable amount and concentration levels of detergent and sanitizing agent.

[0009] The detergent station can comprise a detergent chute for reusing the detergent at the detergent station. Preferably, the detergent chute is installed at bottom of the

detergent station such that used detergent will flow to the detergent chute under gravity, without additional power for pumping.

[0010] The sanitizing station may comprise a sanitizing chute for reusing the sanitizing agent at the sanitizing station. Similar to the detergent chute, the sanitizing chute may collect used sanitizing agent at bottom and circulate the used sanitizing agent to spray heads for cleaning the soiled cart again. Less water or sanitizing resources are required by the present recycling scheme, resulting lower operation cost of the cart washer.

[0011] The cart washer can further comprise an electrolyzed water generator that is connected to the detergent tank or the detergent station for delivering alkali electrolysis water as the detergent. The electrolysed water generator utilises salt water chlorination process whereby dissolved salt (2,500–6,000 ppm) is used as a store for the chlorination system. The electrolyzed water generator is also known as chlorine generator, salt cell, salt generator or salt chlorinator, which uses electrolysis in the presence of dissolved salt (NaCl) to produce hypochlorous acid (HClO) and sodium hypochlorite (NaClO). The electrolyzed water generator can installed locally such that freshly generated alkali electrolysis water and acid electrolysis water can be immediately delivered to detergent washing station and the sanitizing station respectively. Traditional chemical detergents (e.g. anionic detergents, cationic detergents & non-ionic and zwitterionic detergents) or sanitizing agent (i.e. disinfectants are antimicrobial agents) are avoided for cost reduction and environmental protection. For example, alcohols, aldehydes (e.g. formaldehyde and glutaraldehyde) and oxidizing agents (e.g. sodium hypochlorite), phenolics or other sanitizer can be reduced or avoided when using the present cart washer.

[0012] The electrolyzed water generator may be connected to the sanitizing tank or the sanitizing station for giving acid electrolysis water as the sanitizing agent. Hence, sanitizing liquid is conveniently generated by passing electric current through salty water, which is of low cost and energy consumption. The cart washer thus require no additional or regular supply chemical sanitizer, thereby reducing its operation cost.

[0013] The prewash station can comprise a prewash chute for mixing deactivating the detergent, the sanitizing agent, or both the detergent and the sanitizing agent. If the detergent is alkali, whilst the sanitizing agent (disinfectant) is acidic, mixing the detergent and the sanitizing agent together effectively neutralises the two substances, providing neutralised fluid for safe discharge to drainage or rinsing. Therefore, the cart washer offers a low cost, effective and environmentally friendly solution for cart washing.

[0014] The cart washer may further comprise a fluid cavity generator that is connected to one or more of the washing stations for bringing cavities to washing fluid. The washing stations include the prewash station, the detergent station and the sanitizing station. Cavities produced by the fluid cavity generator include millimetre cavities (i.e. diameters around 10^{-3} meter), micro cavities (i.e. diameters around $10^{-3} \sim 10^{-6}$ meter) and ultra-fine cavities (i.e. diameters around $10^{-6} \sim 10^{-9}$ meter). These cavities in washing liquid (e.g. water) may promote the growth of microorganisms and expedite the breakdown of organic matter (e.g. grease). Surfaces of fine cavities have negative charges which attract and attach themselves to organic materials and gives washing liquids a stronger rinsing effect. Washing liquid with numerous cavities may effectively disinfect and reduce both chemical and wastewater discharges. In use, the fluid cavity generator can provide cavities of about one-billionth of a meter, which delve deep into surface imperfections of carts and remove dirt and odours, leaving clean surfaces behind.

[0015] One form of the fluid cavity generator is an ultrasonic generator. The ultrasonic generator causes rapid formation and collapse of minute cavities in its surrounding liquid (e.g. water), known as cavitation. These minute cavities quickly increase in size till their implosion against surface of soiled carts in the washing stations. Energy release of the implosion lifts contamination off inner most recesses of intricately shaped parts, such as from scratches of the carts.

[0016] An alternative form of the fluid cavity generator is a fine bubble diffuser for producing a plethora of small air bubbles in fluid. The fine bubble diffuser can produce oxygen-enriched air cavities in washing liquid, which allows bacteria to produce enzymes for breaking down organic waste.

[0017] The fluid cavity generator may be connected to the detergent tank for providing cavities in the detergent. The fluid cavity generator may be connected in series from a freshwater supply to the fluid cavity generator, and then to the detergent tank.

5 Alternatively, the fluid cavity generator may be connected in series from a freshwater supply to the detergent tank, and then to the fluid cavity generator. The fluid cavity generator may further be connected in parallel with the detergent tank. Accordingly, the fluid cavity generator may generate cavities in detergent, freshwater or both, which provides flexibility for operating the cart washer at various pH values.

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[0018] The fluid cavity generator can be connected to the sanitizing tank for providing cavities in the sanitizing agent. The fluid cavity generator may be connected in series from a freshwater supply to the fluid cavity generator, and then to the sanitizing tank.

15 Alternatively, the fluid cavity generator may be connected in series from a freshwater supply to the sanitizing tank, and then to the fluid cavity generator. The fluid cavity generator may further be connected in parallel with the sanitizing tank. Accordingly, the fluid cavity generator may generate cavities in sanitizing agent, freshwater or both, which provides flexibility for operating the cart washer at various pH values.

20 [0019] In a further embodiment, the fluid cavity generator is preferably connected to the electrolyzed water generator for stabilizing electrolysis water. Hence, the fluid cavity generator may provide salty water filled with air cavities to the electrolyzed water generator for conducting electrolysis process. It is further possible that the fluid cavity generator has two channels connected to alkali electrolysis water and acid electrolysis water from the electrolyzed water generator respectively. Alkali electrolysis water, acid electrolysis water or can be saturated with micro or ultra-fine cavities of air for prolonging or stabilizing effectiveness of the electrolyzed water.

30 [0020] One or more of the washing stations comprise an automatic heater, cooler, or heat exchanger for regulating temperature of washing fluid. The heater or cooler (i.e. chiller) is alternatively known as heat exchanger. The automatic heater can be regulated by thermostats for controlling temperature of washing liquids (e.g. freshwater, alkali electrolysis water, acid electrolysis water) at the one or more washing stations. Particularly, the washing stations can adopt washing liquids with

temperature of lower than 72°C (i.e. degree Celsius) for low temperature washing, in contrast to traditional washing with hot water (i.e. higher than 72°C). In fact, the present cart washer can effectively clean soiled carts with washing liquids at 62°C in most cases. In tropical countries with room temperature of about 25~32°C, the cart washer can successfully wash soiled carts with washing liquids of about 25~45°C or lower, effectively saving a lot of energy for heating.

[0021] The present cart washer may comprises a drying station for removing residue washing liquid from a washed cart. The drying station may incorporate a rotary table, one or more cold/hot gas (air or steam) nozzles, or water-absorbent pads for drying washed carts.

[0022] The cart washer can additionally further comprise a vision inspection station for examining washing quality of the cart automatically. The vision inspection station incorporates one or more cameras that examine soiled or washed carts with machine vision or computer vision such that washing process or washing quality is monitored and controlled. For example, the vision inspection station will reject a washed cart that has food stain. The vision inspection station may causes increase of alkalinity or acidity of washing liquids depending on condition of soiled carts.

[0023] The cart washer may moreover comprise a steam station for cleaning a soiled cart with water steam. The steam station may employ super-heated or saturated water steam for spraying and cleaning soiled carts or the conveyor. The steam station may be optionally powered depending on washing requirements.

[0024] The cart washer can further comprise an Automatically Guided Vehicle (AGV) fetching soiled carts, washed carts or both the soiled carts and the washed carts. The automatically guided vehicle alleviates operators of the cart washer from manually supplying soiled carts to or removing washed carts from the cart washer. The cart washer can thus work independently or integrated with an inflight catering center, reducing dependency and error on human labor.

[0025] The cart washer may further comprise one or more industrial robots for handling carts at the washing stations or drying station. The industrial robots handles

the carts with efficiency and accuracy, whilst human labour may have difficulty in managing bulky, wet, dirty and heavy carts. The industrial robots further alleviate the inflight catering centre from employing workers for 24-hour shift work. Hence, the cart washer deploy one or more industrial robots for washing and/or transporting carts, which provides a modular system for easy configuration. In other words, the cart washer can be easily scaled up or down depending on volume of production (production), whilst robot-integrated stations form a plug and play system, being easily configurable.

[0026] The cart washer can further comprise one or more computers that are connected to the washing stations and drying station of the cart washer for washing soiled carts according to predetermined programmes. Operation parameters (e.g. detergent flow rate, hot air temperature) of these stations are automatically adjusted according to the predetermined programmes.

[0027] The present application can provide an inflight catering centre for providing meal carts to aeroplanes, which comprises the cart washer and a water circulating system that is connected to the cart washer for supplying fresh water or dispose waste water. The inflight catering centre provides convenience and clean environment for operating the cart washer, whether with or without other equipment, such as dishwashers. Accordingly, the cart washer can be integrated with the other equipment for efficient and cost effective operation of the inflight catering centre.

[0028] According to a second aspect, the present application provides a method for using a cart washer. The method comprises a first step of providing detergent to a detergent station; a second step of supplying sanitizing agent to a sanitizing station; and a third step of deactivating the detergent, the sanitizing agent or both the detergent and the sanitizing agent by a neutralization station. The first and the second step may be changed in sequence. Although strong and effective detergent and/or sanitizing agent is/are desired for washing carts efficiently, used detergent and sanitizing agent (e.g. in the form of waste water) often cause damage to environment if discharged directly to drainage. The present cart washer degrades, deactivate, decompose or dilute the detergent or sanitizing agent such that less or no harm to the ambient environment is caused by using the cart washer. Since the cart washer may

require less energy consumption (e.g. less or no heating of water) as compared to traditional cart washer with hot water washing, the cart washer requires less operation cost to users too.

- 5 [0029] The step of deactivating the detergent, the sanitizing agent or both the detergent and the sanitizing agent can comprise a step of mixing the detergent with the sanitizing agent. If the detergent is alkaline and the sanitizing agent is acidic, mixing the detergent and sanitizing agent can effectively cancel acidity and alkalinity of the washing liquids. Neutralised washing liquid (e.g. used water of pH6.7~8.1)
10 causes little damage to fishes and aquatic plants.

- [0030] The method may further comprise a step of providing small, micro, tiny, fine or ultra-fine cavities in the detergent or the sanitizing agent. The cavities may enrich washing liquid with oxygen, hydrogen or carbon dioxide such that the detergent or the
15 sanitizing agent can clean soiled carts more effectively. Alkalinity or acidity level of the washing liquids/agents also becomes more stable and durable (long-lasting).

- [0031] The method can further comprise a step of regulating temperature of the detergent, the sanitizing agent or rinsing fluid to be lower than 72 degree Celsius. In
20 other words, the present cart washer can avoid using hot water (temperature more than 72 degree Celsius) for cart washing with energy saving. In fact, washing liquids (e.g. alkali electrolysis water and acid electrolysis water) of lower temperature (e.g. 23~45°C) are already effective for cleaning typical soiled carts with the cart washer.

- 25 [0032] The method may additionally comprise a step of drying a washed cart. Wet and washed carts may be dried in an arid environment or confinement. Alternatively, washed carts may be dried by wind (e.g. air-knife or steam-knife) or its rotation by centrifugal force. The method can further comprise a step of monitoring or tracking hygiene condition of a cart for regulating washing process. The washing process can
30 be adjusted by changing pH values of detergent, sanitizing agent, flow rate of washing liquids (water), heater temperature, steam temperature and other parameters individually or in combination following impromptu or predetermined programmes.

[0033] The cart washer has an electrolysed (electrolyzed) water generator for generating electrolysed water locally. In other words, the cart washer receives water solutions of sodium hypochlorite and hypochlorous acid for washing carts.

- 5 [0034] The electrolysed water generator that produces electrolysed water onsite. Alkaline water solution near a cathode of the electrolysed water generator is used as detergent, whilst acidic water solution near an anode of the electrolysed water generator is employed as sanitizer. Used alkaline water solution and acidic solution can be mixed for neutralisation such that they can be safely discharged to sewage or
10 ordinary drains.

- [0035] The alkaline water solution serves as detergent for removing oily, protein, fats and stain on carts, whilst the acid water solution is used as sanitizer for removing, germs, bacteria and virus. An alkaline water tank of the cart washer is filled with the
15 alkaline water solution for direct spraying into the detergent washing station to wash the cart. Thereafter, the cart is transported to a sanitizing station such that an acidic water tank is filled with the acidic water solution for direct spraying onto the cart in the sanitizing station. Used/exhausted alkaline and acid water solutions are finally discharged via a common drain mixer in order to neutralise the waste water thus
20 achieving zero impact to the environment.

- [0036] The electrolysed water generator has one or more pH meters in its acidic water tank and alkaline water tank for measuring pH values (acidity or alkalinity) of the water solutions. The one or more pH meters have sensor(s) or measuring probe(s),
25 which are glass electrodes connected to electronic meter(s) for measuring and displaying the pH values. Production rates of the electrolysed water generator are regulated according to the measured pH values at one or more washing stations of the cart dishwasher. For example, the electrolysed water generator adjusts its output rate of alkaline water solution for maintaining pH12.3 or higher at the alkaline water
30 tank and a detergent washing station of the cart washer such that grease on soiled carts can be effectively and efficiently dissolved. In the contrast, the electrolysed water generator regulates its export flow rates of its acidic water solution for maintaining pH6.8 or lowers at a sanitizing station such that germs on the cart may be effectively and efficiently exterminated. An online FAC (Free Active Chlorine Analyser

for electrochemical water treatment) or ORP (Oxygen Reduction Potential) meter can be installed to provide continuous monitoring and ensure the desired level of acidity is maintained at all time for an effective and sustainable sanitizing/sterilizing washing which is more efficient than just monitoring the temperature of the final rinse or using of temperature sensing /thermo-label.

[0037] The cart washer avoid or reduce the use of hot water or steam (e.g. temperature above 70°C) for washing soiled carts. Although hot water and steam are known to be effective for washing carts, especially when used together with chemical detergents, production of hot water and steam consume large amount of energy. Airline catering centers who use the hot water or steam for washing typically suffers from high cost due to the energy consumption. Besides, the chemical detergent is often environmentally damaging and sometimes demands high expenses for removing their harmful environmental effects.

[0038] Accordingly, the cart washer provides its own detergent and sanitizer onsite such that the cart washer requires less or none external supply of detergents and sanitizers. The cart washer has less environmental impact, causing less or none pollution when washing dishes.

[0039] The present cart washer maintains water temperature in some or all of the washing stations to be 50°C or lower. Energy consumption for water heating is greatly reduced or eliminated. Instead, the cart washer deploys electrolysed water to clean soiled dishes effectively, which further has feedback loop(s) for achieving predetermined pH values at designated washing stations. In tropical environment, the cart washer can circulate water of 30°C for cart washing without heating the water at all. In cold environment, the cart washer only needs to warm up the water moderately for washing at 20~30°C in winter seasons. In other words, the present cart washer does not require raise temperature of the water to be above 72°C for dissolving grease or killing germs effectively.

[0040] The present cart washer can include one or more hygiene sensors or analysers that provide real-time or/and on-line continuous measurement of hygiene conditions of carts, which monitor efficacy of detergent washing, sanitizing, and/or

sterilizing processes. The hygiene sensor or analyser comprises machine/computer vision inspector. Alternatively speaking, the cart washer comprises a hygiene sensor in the form of a vision inspection station for examining washing quality of the cart automatically. Concentration levels of detergent(s), sanitizing agent(s) or flow rate(s) of washing or drying may be adjusted depending on hygiene condition of the cart(s) at parts of the cart washer. For example, the cart washer has pH/ORP (oxidation-reduction potential or redox) analysers that are installed at every stations (e.g. detergent station, drying station) of the cart washer. The pH/ORP analysers examines washing quality or hygiene conditions of the cart during the processing of cleaning continuously and progressively. Alternatively, other hygiene quality analysers (e.g. FAC analyser) can be deployed along the conveyor and at various stations of the cart washer. Hygiene sensors include sensors that can monitor cleanliness of the carts, such as W4S-3 Hygiene Sensor (IP 69K-rated photoelectric sensor) and QMH26 Hygienic Sensor. The cart washer thus can track hygiene condition of carts for regulating operating parameters (e.g. pH values, flow rate and washing temperature, etc.)

[0041] The accompanying figure (Fig.) illustrates embodiment(s) and serves to explain principles of the disclosed embodiment(s). It is to be understood, however, that the figure is presented for purposes of illustration only, and not for defining limits of relevant inventions. Exemplary, non-limiting embodiment(s) of the present invention will now be described with references to the above-mentioned figure. Particularly, Fig. 1 presents a schematic diagram of a first cart washer 30; Fig. 2 offers another schematic diagram of a second cart washer 160; whilst Fig. 3 presents a further schematic diagram of a third cart washer 200.

[0042] Following Fig. 1, the first cart washer 30 comprises four washing stations 32-38 that are connected contiguously and sequentially via a conveyor 40 below these stations 32-38. The cart washer 30 further comprises an electrolysed water generator 42 that is joined to a detergent washing station 32 and a sanitising station 34 respectively. The detergent washing station 32 is also termed as detergent station 32.

[0043] In a first embodiment according to Fig. 1, the electrolysed water generator 42 comprises an acidic water tank 44, an alkaline water tank 46, a fresh water tank 48, a

salt container 50, thermostats (not shown), heaters (not shown), valves (not shown), pressure gauges (not shown), pumps (not shown) and a microcontroller (not shown). The acidic water tank 44, the fresh water tank 48, and the salt container 50 are serially connected together. Similarly, the alkaline water tank 46, the fresh water tank 48 and the salt container 50 are also sequentially joined together. In the acidic water tank 44, an anode (not shown) of the electrolysed water generator 42 is inserted into salt water, whilst a cathode (not shown) of the electrolysed water generator 42 is inserted into the alkaline water tank 46.

10 [0044] The conveyor 40 comprises rollers 52, 54 that support a conveyor belt 56 around the rollers 52, 54. The conveyor belt 56 is endless such that the conveyor belt 56 wraps around the rollers 52, 54 tightly for propulsion by the rollers 52, 54. Hence, the conveyor belt 56 has a top side 58 and a bottom side 60 that are joined at their respective ends on the rollers 52, 54. The conveyor belt 56 is positioned at bottoms of
15 the four washing stations 32-38 such that the four (washing) stations 32-38 are adjacent to the top side 58 of the conveyor belt 56.

[0045] According to Fig. 1, the four washing stations 32-38 consist of a detergent washing station 32, a sanitising station 34, a rinsing station 36 and a drying station 38,
20 which are sequentially aligned and contiguously connected along the conveyor 40 from left to right as a process flow direction 62.

[0046] The detergent washing station 32 comprises two detergent top nozzles 64, two detergent bottom nozzles 66 and two detergent columns 68. The top nozzles 64 are
25 fixed at a top side 70 of the detergent washing station 32, whilst the bottom nozzles 66 are attached to a bottom side 72 of the detergent washing station 32. Accordingly, the top nozzles 64 and the bottom nozzles 66 face each other such that water jets from these nozzles 64, 66 spray towards each other from opposite directions, and vertically with respect to the process flow direction 62. In contrast, each of the two
30 detergent columns 68 has an array of spouts 74 that are perpendicularly aligned to their supporting columns. The spouts 74 has several openings respectively such that water jets from these spouts 74 are configured to eject washing liquid horizontally, in the direction of process flow 62. All these nozzles 64, 66 and spouts 74 of the detergent washing station 32 are connected to the alkaline water tank 46 for

discharging pressurised alkali electrolysis water of about pH11.0~12.0. Additionally, the detergent washing station 32 includes a detergent chute 75 joined to the bottom side 72. The detergent chute 75 has tubes (not shown) connected to drainage 77 on a factory floor.

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[0047] The sanitizing station 34 has structure similar to that of the detergent washing station 32. In other words, the sanitizing station 34 comprises two sanitizing top nozzles 76, two sanitizing bottom nozzles 78 and two sanitizing columns 80. The top nozzles 76 are fixed at a top side 82 of the sanitizing station 34, whilst the bottom nozzles 78 are attached to a bottom side 84 of the sanitizing station 34. Accordingly, the top nozzles 76 and the bottom nozzles 78 face each other such that water jets from these nozzles 76, 78 spray against each other in opposite directions, towards middle of the sanitizing station 34. In contrast, each of the two sanitizing columns 80 has an array of spouts 86 that are perpendicularly aligned with respect to their supporting columns 80. The spouts 86 has openings respectively such that sanitizing water jets from the spouts 86 are configured to discharge in the direction of process flow 62, substantially parallel to opposite sides 58, 60 of the conveyor 40. All these nozzles 76, 78 and spouts 86 of the sanitizing station 34 are connected to the acidic water tank 44 for discharging sanitising agent of about pH 2.7~5.0. Furthermore, the sanitizing station 32 includes a sanitizing chute 87 joined to the bottom side 84. The sanitizing chute 87 has pipes (not shown) connected to the detergent chute 75.

[0048] The rinsing station 36 is more compact than the detergent washing station 32 or sanitizing station 34. The rinsing station 36 comprises one rinsing top nozzle 88, one rinsing bottom nozzles 90 and a rinsing column 92. The top nozzles 88 are fixed at a top side 94 of the rinsing station 36, whilst the bottom nozzles 90 are attached to a bottom side 96 of the rinsing station 36. Accordingly, the top nozzles 88 and the bottom nozzles 90 face each other such that water jets from the nozzles 88, 90 spray against each other in opposite directions, towards central portion of the rinsing station 36. In contrast, the sanitizing column 92 has an array of spouts 98 that are vertically aligned. The spouts 98 has openings evenly distributed along the supporting column 92 such that the water jets (not shown) from the spouts 98 are configured to release in the direction of process flow 62. All these nozzles 88, 90 and spouts 98 of the

rinsing station 36 are connected to a water tap (not shown) for receiving and squirting fresh and clean water of pH7.0.

[0049] At an end of the cart washer 30, the drying station 38 has a blower 100 that has several narrow slits (not shown) at its bottom. The blower 100 is attached to a top side 102 of the drying station 36 such that the slits open towards a bottom side 104 of the drying station 36. The rinsing station 36 and the drying station 38 share one rinsing chute 109 that has hoses (not shown) linked to the detergent chute 75.

[0050] When in use, food meal catering carts 106, 108 for washing are secured onto the conveyor belt 56. The conveyor belt 56 has jigs (not shown) such that the carts 106, 108 are secured to the sides 70, 72 of the conveyor belt 56 firmly. According to Fig. 1, the carts 106 108 consists of a first cart 106 for washing and a second cart 108 after the washing, although carts in the washing stations 32, 34, 36, 38 are omitted for clarity. In the meantime, the electrolysed water generator 42 is energised such that sodium chloride water solution (NaCl dissolved into water) is subjected to electric charges or direct current flowing through the anode and cathode. The electrolysed water generator 42 produces electrolysed water (i.e. alkali electrolysis water and acid electrolysis water) accordingly, which is also known as EOW, ECA, electrolyzed oxidizing water, electro-activated water or electro-chemically activated water solution. In particular, hydrogen gas and hydroxide ions are produced at the cathode in the alkaline water tank 46, leading to an alkaline solution that consists essentially of sodium hydroxide.

[0051] In the acidic water tank 44, chloride ions are oxidized to elemental chlorine around the anode of the electrolysed water generator 42 in the acidic water tank 44. Some of this chlorine is combined with some of hydroxide ions from alkaline water tank 46 such that this chlorine disproportionates into hypochlorous acid, as a weak acid and an oxidizing agent. In contrast, in the alkaline water tank 44, hydrogen gas and hydroxide ions are produced at the cathode, leading to an alkaline solution that has essentially of sodium hydroxide (NaClO). Sodium hydroxide is major component of ordinary household laundry bleach. The resulting water at the acid water tank 44 is also known as cleanser and disinfectant / sanitizer. The acidic water solution in the acidic water tank 44 is maintained at about pH2.5~5.0 by sensor control system (not

shown), whilst the alkaline water solution in the alkaline water tank 46 is held at about pH12.3 or above. The acidic water solution, which may be termed as "sanitizer", is propelled from the acidic water tank 44 to the sanitizing station 34. Conversely, the alkaline water solution, which can be called as "detergent", is discharged from the alkaline water tank 46 to the detergent washing station 32. Both the "detergent" and the "sanitizer" are maintained at about $28\pm5^{\circ}\text{C}$ by thermostats and heaters (not shown) in the acidic water tank 44 and the alkaline water tank 46.

[0052] As the rollers 52, 54 (only two are shown) of the conveyor belt 56 rotate clockwise according to Fig. 1, the first cart 106 (soiled cart) is transported into the detergent washing station 32. Upon detecting entry by sensors (not shown) of the detergent washing station 32, both the detergent washing top nozzles 64 and detergent bottom nozzles 66 automatically spray the alkaline water solution to the first cart 106. The spouts 74 on the detergent columns 68 further release the alkaline water solution into the first cart 106 through an open door (not shown) of the first cart 106. The detergent-washing step is carried out for about 42~96 seconds (depending on soiled condition and size of the first cart 106) such that both interior and exterior surfaces of the first cart 106 are cleansed by fresh alkaline water solution from the alkaline water tank 46 and recycled alkaline water solution in the detergent washing station 32. In other words, alkali electrolysis water dripped down from first cart 106 is collected at the detergent chute 75, and further filtered as well as pumped to the spray heads 64, 66 for rinsing the first cart 106 continuously.

[0053] The conveyor belt 56 further transports the first trolley 106 into the sanitizing station 34, after the departure of the first cart 106 from the detergent washing station 32. The sanitizing station 34 also has sensors (not shown) that perceive entry of the first cart 106 such that both the sanitizing top nozzles 76 and the sanitizing bottom nozzles 78 spew the acidic water solution onto all exterior surfaces of the first cart 106. In the meantime, the spouts 86 of the sanitizing columns 80 release pressurised "sanitizer" into interior of the first cart 106. The first cart 106 is sanitised in the sanitizing station 34 for a period of 52~107 seconds for complete cleansing. Used acid electrolysis water that drips down from the first cart 106 is collected by the sanitizing chute 87 such that the used acid electrolysis water is filtered and propelled to the spray heads 76, 86 for cleansing the first cart 106 again.

[0054] Upon finishing the sanitising step at the sanitizing station 34, the first cart 106 is carried forward by the conveyor belt 56 into the rinsing station 36. Similarly, both the rinsing top nozzle 88 and the rinsing bottom nozzles 90 release fresh tap water onto the first cart 106 upon sensing entry of the first cart 106. The spouts 98 of the rinsing column 92 emit streams of highly-pressurised water jets into the first cart 106 via the open-door of the first cart 106. Accordingly, the first cart 106 experiences a "heavy shower" for about 5~28 seconds. The rinsing station 36 has machine vision cameras (not shown) that are connected to microcontrollers (not shown) for examining cleaning quality of the first cart 106. An alarm will be sounded when a hygiene-quality noncompliant cart 106, 108 is detected by the machine vision cameras. The hygiene-quality noncompliant cart 106, 108 will either be pushed aside for human inspection, or returned back to the sanitizing station 34 for washing again. In contrast, if the first cart 106 meets predetermined hygiene-quality requirement, the first cart 106 is carried forward to a next washing station.

[0055] The drying station 38 is activated when its sensors (not shown) identify entry of the first cart 106. The blower 100 is energised such that pressurised hot air steams are released from the narrow slits in forming parallel air sheets, known as air-knives. The air-knives push residue water from top towards bottom of the first cart 106 such that the first cart 106 is made dry. Residue water from both the drying station 38 and the rinsing station 36 are accumulated by the rinsing chute 109 so that amassed water is sieved and driven to the spray heads 88, 90, 98 for bathing the first cart 106 again. At the drying station 38, the first cart 106 is further locked by a rotary platform (not shown) such that the first cart 106 spins at high speed (e.g. 180~2,000 round per minute). Residue water inside the first cart 106 flies off the first cart 106, when the exterior of the first cart 106 is under the air-knives in the meantime. The drying station 38 takes about 56~96 seconds to cause the first cart to be sufficiently dry. Nevertheless, since the sensors monitor the drying step continuously, the drying step will only stop when the sensors detect no water residue in and on the first cart 106. Upon completion, the first cart 106 is released from the lock and carried out of the drying station 38, known as a second cart 108.

[0056] Waste water or water solutions from the detergent washing station 32, the sanitizing station 34, the rinsing station 36 and the drying station 38 are collected together for discharging to a drainage 77 or sewage system. Particularly, used acidic water solution from the sanitizing station 34 and used alkaline water solution from the detergent washing station 32 are combined and neutralised before entering the drainage 77.

[0057] Another embodiment of the invention is illustrated by Fig. 2, which offers another schematic diagram of a second cart washer 160. The second cart washer 160 comprises parts of method steps that are similar or identical to those of the first embodiment. Description of the similar or identical part or method steps is hereby incorporated by reference, wherever relevant and appropriate.

[0058] In detail, the second cart washer 160 comprises five washing stations 162, 32-38 that are connected consecutively via a conveyor 40 below these stations 162, 32-38. The second cart washer 30 additionally comprises a fluid cavity generator 165 that is connected between an electrolyzed water generator 42 and a fresh water tank 48.

[0059] The five washing stations 162, 32-38 include a prewash station 162 that is sequentially connected to and followed by a detergent station 32, a sanitizing station 34, a rinsing station 36 and a drying station 38. The prewash station 162 comprises prewash top nozzles 164 on a top side 166 of the prewash station 162, and prewash bottom nozzles 168 on a bottom side 170 of the prewash station 162. The prewash station 162 additionally comprises brushing wheels 172 attached to lateral walls of the prewash station 162 such that the brushing wheels 172 are configured to scrub walls of carts in the prewash station 162. The prewash station 162 comprises a prewash chute 174 at bottom 170 such that used water or washing liquid is collected at the prewash chute 174 before discharging to the drainage 77.

[0060] Moreover, the second cart washer 160 comprise conduits 176, 178, 180, 182, 184, and pumps 186, 188, 190, 192 that join the chutes 174, 75, 87, 109. In detail, the second cart washer 160 includes a prewash conduit 176 connected to a bottom side of the prewash chute 174, a detergent conduit 178 connected to a bottom side of the

detergent (washing) station 32, a sanitizing conduit 180 joined to a base of the sanitizing station 34 and a rinsing conduit 182 linked to a floor of the rinsing chute 109. A rinsing pump 186 is further installed at a lower end of the rinsing conduit 182, a sanitizing pump 188 is fixed at a bottom end of sanitizing conduit 180, a detergent pump 190 is interconnected to a terminal of the detergent conduit 178, whilst a prewash pump 176 is joined to a bottom end of the prewash conduit 192. Horizontally, these pumps 186, 188, 190, 192 are coupled together via a common conduit 184.

[0061] When the second cart washer 160 in use, the freshwater tank 48 receive a portion of salt from the salt container 50 so that salt is dissolved in the freshwater for maintaining predetermined concentration levels. When salty water passes through the fluid cavity generator 165, the fluid cavity generator 165 causes the salty water passing over an external surface of a porous cylinder and inject highly pressurised air onto an internal surface of the porous cylinder such that large amount of fine cavities of air are generate in the salty water. The salty water will appear milky in colour due to suspension of the find cavities. In practice, the fluid cavity generator 165 provides micro cavities of 10^{-3} to 10^{-6} meters in diameter in the salty water. Using different parameters (e.g. cylinder with smaller holes, higher air pressure and faster speeds of air & salty water), the fluid cavity generator can generate ultra-fine cavities of 10^{-6} to 10^{-9} meters in the salty water. In other words, the fluid cavity generator saturates the salty water with tiny cavities, which have sizes similar to those of human cells (about 10^{-5} meters) and virus (about 10^{-8} meters). Accordingly, those fine cavities of air is the salty water can suspend in the salty water for a prolonged period of time, typically more than 2~3 days.

[0062] Salty water saturated with find cavities is further pumped into the electrolyzed water generator 42 such that alkali electrolysis water as detergent is delivered to the detergent station 32 for spraying by the nozzles 64, 66. In contrast, acid electrolysis water from electrolyzed water generator 42 as sanitizing agent is supplied to the sanitizing station sanitizer (also known as sanitizing agent or cleansing agent). Similar to the first cart washer 30, used detergent is collected at the detergent chute 75, used sanitizing agent is accumulated at the sanitizing chute 87, and used rinsing water is gathered at the rinsing chute 109. However, fresh rinsing water comes directly from

an outlet of the fluid cavity generator 165 such that the fresh rinsing water is also saturated with fine or ultra-fine cavities of air.

[0063] Additionally, as the soiled cart 160 enters the first washing station 162 (i.e. prewash station), prewash top nozzles 164 and prewash bottom nozzles 168 eject water streams of water onto the soiled cart 160. In the meantime, the brushing wheels 172 rotate and scrub exterior surfaces of the soiled cart 160 for removing food debris or stains.

[0064] The second cart washer 160 has a water recycling system 194 and detergent neutralisation system 196. The water recycling system 194 comprises the chutes 174, 75, 76, 87, 109 and these chutes 174, 75, 76, 87, 109 collect washing liquids of their respective washing stations 162, 32, 34, 36, 38 such that their pumps 192, 190, 188, 186 propel accumulated washing fluids at these chutes 174, 75, 76, 87, 109 and further spray onto soiled carts 106 at these respective stations 162, 32, 34, 36, 38 for washing. Sensors (not shown) are installed at these chutes 162, 32, 34, 36, 38 such that contaminated or used washing fluids are propelled to the prewash station 162 for an initial cleaning of the soiled cart 106. Used washing fluid (dirty water) from the prewash station 162 is subsequently discharged to the drainage 77.

[0065] The detergent neutralisation system 196 comprises parts of the second cart washer 160, which particularly includes the detergent station 32, the sanitizing station 34 and the prewash station 164. In the second cart washer 160, cavity-filled alkali electrolysis water of pH11.0~13 is used as detergent for dissolving oil or grease, whilst cavity-filled acid electrolysis water of 2.0~5.0 is employed as cleansing agent for eliminating bacteria, deodorisation and bleaching. Used alkali electrolysis water and acid electrolysis water are collected at their respective chutes 75, 87. The used alkali electrolysis water and acid electrolysis water are further mixed at the prewash chute 174 such that the prewash station 162 can circulate used water of pH value about 6.5~8.0 for sluicing the soiled cart 106 in the prewash station 162. Dirty water from the prewash station 164 is released to the environment by the drainage 77 next to the second cart washer 160.

[0066] Fig. 3 presents a further schematic diagram of the third cart washer 200. The third cart washer 200 comprises parts of method steps that are similar or identical to those of the first embodiment. Description of the similar or identical part or method steps is hereby incorporated by reference, wherever relevant and appropriate. The third cart washer 200 is also known as an automated (automatic) cart washer because stations of the third cart washer 200 are programmed such that the third cart washer can operate independently, without human intervention. When operated together with AGV (automated guided vehicle or automatic guided vehicle) for carrying soiled carts to the third washer 160 and cleaned carts away from the third cart washer 200, the third cart washer 200 becomes an integral part of an inflight catering centre, which integrates cart washing, food preparation and meal packaging together seamless and automatically.

[0067] The third cart washer 200 has a detergent station 32, a sanitizing station 34, a drying station 38 and a cart transporter 40 that are connected together. The cart transporter 40 is alternatively known as conveyor 40 for moving carts along various washing stations. The detergent station 32, the sanitizing station 34 and the drying station 38 comprise a detergent robot 202, a sanitizing robot 204 and a drying robot 206 respectively. The detergent robot 202 has an end effector in the form of spray nozzle 64 for discharging alkali electrolysis water. The sanitizing robot 204 has an end effector in the form of spray nozzle 76 for discharging acidic electrolysis water. The drying station 38 has an end effector in the form of blower 100 for releasing hot air or super-heated steam. The third cart washer 200 is a plug and play cart washing system that is installed along a moving path of an inflight catering centre. The cart transport system (i.e. conveyor 40) is provided along a side wall of the inflight catering centre, which occupies less product floor and fewer human operators. The third cart washer 200 is operated by programmed computers such that the robots 202, 204, 206 utilises alkali electrolysis water as detergent, acidic electrolysis water as sanitizing agent and hot air as drying agent for cleaning carts automatically, known as auto self-washing or cart auto-washing. These stations 32, 34, 38 are enclosed in a tunnel such that used washing liquids are recycled and prevented from splashing to ambient equipment. Alternatively, each of these stations 32, 34, 38 are individually enclosed by transparent plastic enclosures. The third cart washer 200 has tank

drainage below product floor (not shown) where used detergent and sanitizing agent are mixed and neutralised before discharging to drainage 77.

[0068] In the application, unless specified otherwise, the terms "comprising",
5 "comprise", and grammatical variants thereof, intended to represent "open" or
"inclusive" language such that they include recited elements but also permit inclusion
of additional, non-explicitly recited elements.

[0069] As used herein, the term "about", in the context of concentrations of
10 components of the formulations, typically means +/- 5% of the stated value, more
typically +/- 4% of the stated value, more typically +/- 3% of the stated value, more
typically, +/- 2% of the stated value, even more typically +/- 1% of the stated value,
and even more typically +/- 0.5% of the stated value.

[0070] Throughout this disclosure, certain embodiments may be disclosed in a range
15 format. The description in range format is merely for convenience and brevity and
should not be construed as an inflexible limitation on the scope of the disclosed
ranges. Accordingly, the description of a range should be considered to have
specifically disclosed all the possible sub-ranges as well as individual numerical
20 values within that range. For example, description of a range such as from 1 to 6
should be considered to have specifically disclosed sub-ranges such as from 1 to 3,
from 1 to 4, from 1 to 5, from 2 to 4, from 2 to 6, from 3 to 6 etc., as well as individual
numbers within that range, for example, 1, 2, 3, 4, 5, and 6. This applies regardless of
the breadth of the range.

[0071] It will be apparent that various other modifications and adaptations of the
25 application will be apparent to the person skilled in the art after reading the foregoing
disclosure without departing from the spirit and scope of the application and it is
intended that all such modifications and adaptations come within the scope of the
30 appended claims.

Reference Numerals

	30	cart washer
	32	detergent washing station
5	34	sanitizing station
	36	rinsing station
	38	drying station
	40	conveyor
	42	electrolyzed water generator
10	44	acidic water tank
	46	alkaline water tank
	48	fresh water tank
	50	salt container
	52	first roller
15	54	second roller
	56	conveyor belt
	58	top side
	60	bottom side
	62	process flow direction
20	64	detergent top nozzles
	66	detergent bottom nozzles
	68	detergent columns
	70	top side
	72	bottom side
25	74	spouts
	75	detergent chute
	76	sanitizing top nozzles
	77	drainage
	78	sanitizing bottom nozzles
30	80	sanitizing columns
	82	top side
	84	bottom side
	86	spout
	87	sanitizing chute

	88	rinsing top nozzle
	90	rinsing bottom nozzles
	92	rinsing column
	94	top side
5	96	bottom side
	98	spouts
	100	blower
	102	top side
	104	bottom side
10	106	first cart
	108	second cart
	109	rinsing chute
	160	second cart washer
	162	prewash station
15	164	prewash top nozzles
	165	fluid cavity generator
	166	top side
	168	prewash bottom nozzles
	170	bottom side
20	172	brushing wheels
	174	prewash chute
	176	prewash conduit
	178	detergent conduit
	180	sanitizing conduit
25	182	rinsing conduit
	184	common conduit
	186	rinsing pump
	188	sanitizing pump
	190	detergent pump
30	192	prewash pump
	194	water recycling system
	196	detergent neutralization system
	200	third cart washer
	202	detergent robot

204 sanitizing robot

206 dying robot

Claims

1. Cart washer (30, 160, 200) comprising
 - A detergent station (32) for cleaning soiled cart (106) with detergent;
 - 5 – A sanitizing station (34) connected to the detergent station (32) for disinfecting the soiled cart (106) with sanitizing agent; and
 - A prewash station (162) connected to the detergent station (32) or the sanitizing station (34) for deactivating the detergent, the sanitizing agent or both the detergent and the sanitizing agent.
- 10 2. Cart washer (30, 160, 200) according to Claim 1 further comprising
A conveyor (40) that is connected to the detergent station (32), the sanitizing station (34), the prewash station (162) or a combination of any of these stations (32, 34, 162) for transporting soiled cart (106) for washing.
- 15 3. Cart washer (30, 160, 200) of any of the preceding Claims further comprising
A detergent tank (46) that is connected to the detergent station (32) for delivering the detergent; and
A sanitizing tank (44) that is connected to the sanitizing station (34) for
20 supplying the sanitizing agent.
- 25 4. Cart washer (30, 160, 200) of any of the preceding Claims, wherein
The detergent station (32) comprises a detergent chute (75) for reusing the detergent at the detergent station (32).
5. Cart washer (30, 160, 200) of any of the preceding Claims, wherein
The sanitizing station (34) comprises a sanitizing chute (87) for reusing the sanitizing agent at the sanitizing station (34).
- 30 6. Cart washer (30, 160, 200) of any of the preceding Claims further comprising
An electrolyzed water generator (42) that is connected to the detergent tank (46) or the detergent station (32) for delivering alkali electrolysis water as the detergent.

7. Cart washer (30, 160, 200) according to Claim 6, wherein
The electrolyzed water generator (42) is connected to the sanitizing tank (44)
or the sanitizing station (34) for giving acid electrolysis water as the sanitizing
agent.

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8. Cart washer (30, 160, 200) of any of the preceding Claims, wherein
The prewash station (162) comprises a prewash chute (174) for mixing
deactivating the detergent, the sanitizing agent, or both the detergent and the
sanitizing agent.

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9. Cart washer (30, 160, 200) of any of the preceding Claims further comprising
A fluid cavity generator (165) that is connected to at least one of the washing
stations (162, 32, 34) for bringing cavities to washing fluid.

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10. Cart washer (30, 160, 200) according to Claim 9, wherein
The fluid cavity generator (165) comprises an ultrasonic generator.

11. Cart washer (30, 160, 200) of Claim 9, wherein
The fluid cavity generator (165) comprises a fine bubble diffuser for producing
a plethora of small air bubbles in fluid.

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12. Cart washer (30, 160, 200) of any of the preceding Claims 9 to 11, wherein
The fluid cavity generator (165) is connected to the detergent tank (46) for
providing cavities in the detergent.

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13. Cart washer (30, 160, 200) of any of the preceding Claims 9 to 12, wherein
The fluid cavity generator (165) is connected to the sanitizing tank (44) for
providing cavities in the sanitizing agent.

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14. Cart washer (30, 160, 200) of any of the preceding Claims 9 to 13, wherein
The fluid cavity generator (165) is connected to the electrolyzed water
generator (42) for stabilizing electrolysis water.

15. Cart washer (30, 160, 200) of any of the preceding Claims 9 to 14, wherein
At least one of the washing stations (162, 32, 34) comprises an automatic
heater for regulating temperature of washing fluid.
- 5 16. Cart washer (30, 160, 200) of any of the preceding Claims further comprising
A drying station (38) for removing residue washing liquid from a washed cart
(108).
- 10 17. Cart washer (30, 160, 200) of any of the preceding Claims further comprising
At least one hygiene sensor for checking of hygiene conditions of a cart.
18. Cart washer (30, 160, 200) of any of the preceding Claims further comprising
A steam station (38) for cleaning a soiled cart (106) with water steam.
- 15 19. Cart washer (30, 160, 200) of any of the preceding Claims further comprising
An automatically guided vehicle fetching soiled carts (106), washed carts (108)
or both (106, 108).
- 20 20. Cart washer (30, 160, 200) of any of the preceding Claims further comprising
An industrial robot (202, 204, 206) connected to at least one of the stations
(162, 32, 34, 36, 38) for handling carts (106, 108).
- 25 21. Cart washer (30, 160, 200) of any of the preceding Claims further comprising
At least one computer connected to the stations (162, 32, 34, 36, 38) of the
cart washer (30, 160, 200) for washing soiled carts (106) according to
predetermined programmes.
- 30 22. Method of using a cart washer (30, 160, 200) comprising
 - Providing detergent to a detergent station (32);
 - Supplying sanitizing agent to a sanitizing station (34); and
 - Deactivating the detergent, the sanitizing agent or both the detergent and
the sanitizing agent by a neutralization station (162).

23. Method of using a cart washer (30, 160, 200) according to Claim 22, wherein
The deactivating the detergent, the sanitizing agent or both the detergent and
the sanitizing agent comprises mixing the detergent with the sanitizing agent.
- 5 24. Method of using a cart washer (30, 160, 200) according to Claim 22 or 23
further comprising
Providing fine cavities in the detergent or the sanitizing agent.
- 10 25. Method of using a cart washer (30, 160, 200) according to any of the preceding
Claims 22 to 24 further comprising
Regulating temperature of the detergent, the sanitizing agent or rinsing fluid to
be lower than 72 degree Celsius.
- 15 26. Method of using a cart washer (30, 160, 200) according to any of the preceding
Claims 22 to 25 further comprising
Monitoring hygiene condition of a cart (106, 108) for regulating washing
process.
- 20 27. Method of using a cart washer (30, 160, 200) according to any of the preceding
Claims 22 to 26 further comprising
Drying a washed cart (108).