Description

I Title

(0001) Waste Water Tank for Zero Waste

II Technical Field

(0002) The invention is a waste water tank (hereinafter named WT) exposed to atmospheric pressure, for use in the point of use Reverse Osmosis Water Filtration System (hereinafter named RO system) for purpose of salvaging the waste water produced during the filtration process for usage. It is designed relying on the technical advantages of the Atmospheric Tank RO system (hereinafter named AST RO system) under Patent application PCT/SG2018/000001 (ISA report WO 2019/143290). The design makes use of the kinetic energy in the flowing water from the pipeline to the faucet, and gravitational kinetic energy of waste water from the WT, both naturally existing when faucet is turned on, without any electrical device for functioning. It is primarily designed to be used on an AST RO system to achieve the target of zero waste, but it can also be used on an existing pressure tank RO system for partial salvage. All is applying the theory in Physic. Although the present invention bears some similarity to patent 11201708362P under the same applicant, in terms of function and purpose, the present application has additional functions and simplicity in design with variation in specifications and claims, which is made possible by the application PCT/SG2018/000001.

III Background

(0003) The RO system, used on a pipeline water supply source for a point of use system, residential mainly, drains away a high percentage of water during the process of filtration to obtain a relatively low percentage of purified water for consumption. The water drained away is usually called waste water. This has been the drawback of the RO system for about a century since the day the RO system exists in the water filtration point of use market.

(0004) The water discharged or drained away in the ordinary pressure tank RO system has been generally named “waste water” for convenience, but in fact it is debatable whether it should be named waste water as it is cleaner than the source pipeline water when it is drained away after it has passed through the pre-filters of the filtration system. So it is cleaner in the sense that the TSS (Total Suspended Solids) would have been removed from the source water. The only issue is the TDS (Total Dissolved Solids) would be higher after passing through the pre-filters but should not be much higher. The quality of the so-called waste water of the RO system is in fact better than that of the pipeline water in many places as solid sediments have been deemed removed. Even if one do not salvage for drinking, it is at least good for other purposes like cooking, washing utensils, vegetables and etc which the original pipeline water is also suitable for.

(0005) The efficiency of RO systems differs amongst different brands. It varies from 1:4 onward based on market information approximately. In other words, to obtain one part of purified water,

4 parts or more of source water have to be drained away. But in fact the ratio is actually much higher. The pressure tank RO system functions on the pressure level in the tank. Briefly, when the pressure in the pressure tank system gets higher and higher, until it reaches a pre-set limit, it triggers the electronic device to cut off the water supply. But when approaching the shut off point of the water supply, the ratio can become 1:20 while the efficiency of the RO system drops. The efficiency of the RO system drops because the effective pressure on the filtration system reduces as the back pressure from the pressure tank increases. When the effective pressure is getting lower and lower progressively, the filtration efficiency also drops gradually and it can become 1:20. This does not bother anyone when it is not made aware.

(0006) The invention in PCT/SG2018/000001 with an AST RO system in place of the pressure tank system can reduce the amount of waste water because the AST RO system open and close the water supply to the filtration system abruptly and maintains a rather constant water pressure and efficiency and hence a rather constant waste water ratio. This has further given rise to the possibility of estimating the volume of the waste water during the process of filtration fairly accurately, unlike in the case of pressure tank system where it is difficult to assess, and the preliminary volume of the WT can be estimated when AST RO system is adopted.

(0007) The traditional RO system comprise of a filtration system, a pressure tank, a post filter for taste issue and electric pump usually. There is no waste water tank in the traditional RO system.

Listed below are further advantages of AST RO system which affects design of WT.

(0008) 1 saving in volume/space

The AST RO system not only produces a lower amount of waste water, there is also a reduction in volume of about 50% of the AST when compared with a pressure tank system with a bladder bag in it, which causes an effective balanced volume of storage capacity to be reduced to approximately 50% as the AST RO system does not function on level of pressure. So a twenty liters pressure tank capacity will now approximately be ten liters when it is replaced with an AST RO system; and the volume of the WT will be to match this smaller volume of the AST.

0009) 2 shorter cycle time

The AST RO system has a shorter cycle time between opening and closing of the valve of the water supply which is set to low volume of dispensing of water for opening of the valve to start the filtration system, and the system will remain operating until AST RO system is filled up. Whereas the pressure tank RO system, to have the equivalent limit for opening of the water supply will mean that the pressure tank RO system will be functioning at very low efficiency. This is because if only a slight drop in pressure in the tank will trigger the opening of the water supply, the system would have to function at high back pressure which will result in low efficiency and with high waste water ratio. In short, for a pressure tank RO system, it is not advisable for pragmatic reason, to set the limit for opening of the water supply at level too close to the closing level as it would be functioning under high back pressure,

while it is also not logical to set the closing and opening level too low, which would mean reduction of storage capacity of the tank when it is already low with a bladder bag in it, and at the same time minimum pressure level is required for dispensing the water stored. These are opposing factors. The longer cycle time where the filtration system rests is a drawback of the pressure tank system. Whereas the AST RO system will not have any issue as it is working on water level in the AST for control of opening of the valve of water supply and function under the same pipeline pressure all the time. So with the AST RO system, it is possible to have a smaller AST and therefore smaller WT as the filtration of the AST RO system will function most of the times.

(0010) 3 speed of filtration

The AST RO system will function at the pressure of the pipeline it is connected to and therefore speed of filtration will be the same highest all the times and therefore smaller AST is possible and smaller WT. This also can ensure the same waste water ratio all the times.

(0011) 4 electricity and post filter

The AST RO system does not require an electric pump, or any electrical device to function. And without the pressure tank and therefore the bladder bag, it does not require post filter to improve taste as the bladder bag is the main source of taste issue. This again is a plus point for space saving on overall configuration of the AST RO system with the WT.

(0012) 5 no robust structural design required

The AST RO system operates under normal pipeline pressure and is not subject to increase during filtration, the structural design of the components of the whole system can all be trimmed down to a design to suit normal pipeline pressure. This affects the filtration system and can save weight and size which invariably will leave more space for the WT to fit in with a more compact design in a compact system.

(0013) The above summarize the points that the waste water from existing RO system is high and wasteful and with the invention of the AST RO system which has technical advantages listed above, it would appear to be feasible to have a reasonable size WT for salvaging all waste water for usage to achieve the target of zero waste as amount of waste water now is much more lower. The WT will be in sensible size when it is used with an AST RO system. The details are as described below.

IV Disclosure

(0014) Meaning of technical terms and descriptive phrases used in the context of this application

(0015) 1 AST RO system

It is a RO filtration system adopting the Atmospheric Storage Tank (AST) under application PCT/SG2018/000001, ISA WO/2019/143290, which open and close the water supply abruptly based on water level in the tank, rather than pressure in the traditional pressure tank, for storing the filtered water. AST stands for Atmospheric Storage Tank.

(0016) 2 zero waste AST RO system

It refers to an AST RO system which has means for salvaging the waste water completely from the filtration process for usage without draining and or discharge into the drainage, and in the present context the means is by way of a WT as described herein.

(0017) 3 miniature gate valve on weighted float

It is a gate valve (Fig 3, Fig 4) miniature in size fixed on top of the weighted float both contained within a circular enclosure that protrudes above the top of the WT, used for opening and closing of water supply to the RO system automatically. The weighted float, the weight added in relation to the floating power of the float will enable the combined structure to float, and move with water when the water level goes up for closing of the valve and at the same time will give the weighted float a required downward pulling force when the water level is lowered for disengaging from the closed position for opening of the valve. The top part of the gate valve is in white and will be exposed to view when closed and recede into flush position when open. White indicates closed.

(0018) 4 pumping gadget with flow control section

It is a mechanical gadget which has two miniature flywheels (name burrowed for resemblance only, does not function as real flywheel in terms of functions) connected with an axle rigidly through the axis, without the need of using electricity, it functions on the kinetic energy from the pipeline flowing water assisted by gravitational kinetic energy from flow of waste water from the WT, with flow control section which function like a ball check valve, for purpose of pumping the waste water for usage in the manner and details as described herein.

(0019) 5 waste water ratio

Waste water is the water produced at the same time with but separate from the filtered water from a RO system during filtration process, which is the subject matter of the application herein. Waste water ratio is the proportion comparing the amounts of filtered water and the waste water during filtration process.

(0020) 6 cycle time

It is the duration between closing and opening of the water supply to an AST RO system or RO system during which the filtration system rests.

(0021) 7 gravitational kinetic energy

It means kinetic energy created by gravity/gravitational force.

(0022) Scope of application and design of WT

(0023) 1 for both AST RO system and existing RO system

The WT invented is for salvaging the waste water from an AST RO system for usage mainly. The WT can also be installed on an existing RO system where pressure tank is used, but the zero waste targets may not be achieved satisfactorily but partial salvage is possible or unless extension tank is used to increase storage capacity of WT, but the extension tank will not have the pumping gadget as well as the miniature gate valve on weighted float as they are no more required. The extension tank must be equal or taller in height as the main tank inclusive of the protrusion to maintain the same highest point. This is covered under (0047).

(0024) 2 function independently

The WT is added without affecting the filtration system, i.e. the pre-filters and the RO unit is to function as per normal and is independent of the functions of the WT and the AST, except when the gate valve for emergency stoppage is activated, the water supply to the AST RO system or RO system will also be terminated. And there will be connection for leakage or seepage from the AST valve box to the WT. Other than that, it does not interfere with the filtration system. The filtered water outlet from the filtration system will be connected to the AST and the waste water outlet will be connected to the WT. The WT will be installed next to the AST and the filtration system. The new zero waste AST RO system will now have an AST, a WT and the RO filtration system as a complete system in one location without electrical wiring, pump and post filter; or alternatively, with the filtration system installed away at the same level, from the WT and AST to match space constraint requirement or preference.

(0025) 3 contingency allowance

The WT is designed to store the amount of waste water produced by an AST RO system which will be much lower when compared with the pressure tank system as the AST RO system open and close the water supply abruptly. The size of the WT will be to contain the waste water discharged from an AST RO system as envisaged, with contingency allowance which is added-on to the preliminary volume of WT based on waste water ratio of 1:4 or the actual ratio, unless when it is to be adopted for an existing RO

system where there is no space constraint and bigger size WT and or extension tank is used.

(0026) 4 friction

The WT is made of conventional materials usually used in the water filter industry. Selection of materials will be based on the criteria of having low frictional resistance mainly.

(0027) 5 shape and size of WT

There is no specific requirement on the shape of WT except to suit the dimension of the AST RO system in terms of configuration of the whole system, to form a basically rectangular overall shape for aesthetic purpose. The WT is basically rectangular in shape and mostly covered, with only a small circular protrusion on top for the miniature gate valve (Fig 1 ref 1, ref 2) as described above and with exposure to the atmosphere at the same location; (Fig 1 ref 4) is indicative support frame. But there is no restriction or requirement on shape of WT generally and in particular when used on an existing RO system where space constraints would call for an “L” shape or other shapes WT and or, if the available space, under the sink or out of it, and where extension tank is used, can accommodate more than one WT connected at the bottom as the WT is an atmospheric tank and will be able to function as one WT so long as they are of the same height or with extension tank taller, and installed on the same level. But the extension tank shall not have the miniature gate valve on weighted float and pumping gadget as described above as they are no more required for the extension tank is only for increasing storage capacity.

(0028) Invention

The “Waste Water Tank for Zero Waste” is a component, (Fig 1 ref 1, all drawings are not drawn to scale) front elevation view (Fig 2) plan view, designed to be part of a point of use AST RO system, can also be used on an existing RO system, comprising of an atmospheric water tank with contingency allowance in volume for storage of waste water, two provisions for dispensing the waste water stored, one a pumping gadget (Fig 5 side elevation) with flow control section(Fig 7 ref 16), for pumping of waste water combined with pipeline water for usage, and the other a faucet for direct dispensing of the waste water in the WT (Fig 1, Fig 2 ref 3) for usage, a miniature gate valve on a weighted float (Fig1 ref 2, Fig 3, Fig 4) for cutting off the water supply in the event of over usage together with an indicator for such incident when happened; and on completion of installation, can salvage the waste water in the WT for usage when either of the faucets is turned on, making use of the kinetic energy in the flowing water of the pipeline and the gravitational kinetic energy of the waste water flow from the WT, through the sink faucet for a combination of pipeline water and waste water, and or making use of the gravitational kinetic energy of the waste water from the WT through the direct dispensing faucet with only waste water, to achieve the target of zero waste when an AST R0 system is adopted, and to achieve partial salvage when installed with an existing RO system, with the emergency cutting off of water supply on standby position which will be activated automatically when over usage happens.

(0029) The size of the AST in a AST RO system with a set of filtration membranes and materials selected for the filtration system will determine the required storage capacity of the WT. The amount of waste water from an AST RO system will be fairly constant as explained above, but a margin for contingency has to be allowed for in the design to determine the final volume of the WT for the AST RO system based on a set of filtration membranes and materials selected considering the four factors below. (Filtration membranes and materials are not part of the present application)

(0030) 1 bigger than exact requirement

The size will have to be bigger than the estimated size based on the ratio of 1 to 4 or other ratio depending on the membranes and materials selected. When the size is based on the ratio for an AST RO system, with the AST and WT filled up, there will be overflow once there is any dispensing on the AST side which causes further filtration. So a margin of contingency as float has to be added to the preliminary volume of the WT determined by using the waste water ratio.

(0031) 2 poor maintenance

Allowance will have to be made for poor maintenance. When the RO system membrane aged substantially, the waste water ratio will increase. This is because when the filters or the RO system membrane is used beyond the expected maintenance period and mostly blocked, the filtration system would require a higher than normal pressure for the water to flow through, which is not possible for installation without a pump, and will result in a slower

filtration rate and higher waste water ratio; so a percentage of contingency will have to be added to the volume estimation to cater for this.

(0032) 3 heavy usage

Unexpected heavy usage will also cause an overflow to happen. Usage pattern of the AST RO system assumed may be inaccurate and the design has to cater for it. A further percentage will have to be added to the estimation for volume of WT.

(0033) 4 other factors

The WT is designed to match the AST RO system. When the system is installed, there is discharge connection from the AST to the WT for seepage or leakage from the AST valve box. When the AST is required to be installed below outlet level of faucet, there will be connection for discharge of the pipeline water into the WT for driving the filtered water upward for usage, but this is only an assumption of possible application of AST and it is not recommended. There is also possible leakage or seepage from the WT miniature gate valve which is directly on top of the WT. Further allowance will have to be made.

(0034) A 20% margin is added to the size of the WT to cover the above factors in the design, based on a set of filtration materials. The percentage is approximate estimation and can be adjusted when necessary. Furthermore, the advantage of having shorter cycle time and the same high filtration rate for the AST and therefore smaller AST and WT is not considered as it is difficult to estimate, it depends on pattern of usage. It is left

unutilized in the estimation of reduction in volume of AST and therefore WT, but utilized in terms of fulfilling the requirement of an on-demand point of use system with a higher probability of achieving it in the sense that there likely will always be filtered water in the AST most of the time. The added-on percentage is based on actual amount of waste water with a set of pipeline pressure and filtration materials and membranes but should not be higher than 1:4 ratios. The four factors mentioned above are independent from each other and the first being part of the design requirement, and it is unlikely that the remaining three can happen all at the same time. So the WT will be utilized up to 80% when the AST is filled up to 100%, leaving an air space of 20%. This should be sufficient to prevent over usage. In any case, there is a provision for an emergency stoppage to avoid overflow, which function automatically, as described below in (0045) for achieving target of zero waste.

(0035) For usage of waste water salvaged the WT has two provisions as mentioned below which will ensure usage of the waste water regularly whenever any of the faucets is turned on.

(0036) Regular usage of waste water combined with pipeline water

(0037) The WT is designed to match the AST RO system. The AST RO system is recommended to be installed at level higher than outlet level of faucet. This invariably calls for the filtration system and the WT to be installed at the same level as, if they are installed at any level lowered than that of the AST, there will be problem of gravity to overcome to deliver the purified water to the

AST. At this level, the WT can dispense water through the additional direct faucet under the WT utilizing gravity. But the pumping gadget will be required to ensure flow when dispensing is through the existing faucet as, likely, it will involve pumping the waste water upward against gravity. This is suitable for both Installations above and below outlet level of the existing faucet.

(0038) The pumping gadget (Fig 5) with dimension to suit requirement, has two miniature flywheels of the same diameter which can be varied if necessary, one driving wheel (Fig 5 ref 12, section B-B Fig 6) and the other delivering wheel (Fig 5 ref 13, section C-C Fig 7) , and they are connected by a common axle rigidly (Fig 6, Fig 7 ref 17), meaning they will rotate as one and will rotate concurrently at same speed when force is applied to either one. The driving wheel will be driven by the pipeline flowing water and the delivering wheel will drive and deliver the waste water; rotating at the same speed in the same direction, one is action and the latter is reaction the resisting force. On the perimeter of the flywheels are fins with size to match the flow; on the sides of the flywheels are two covering plates which are fixed to the sides of the fins. The plates are separated from the surface of the cover to prevent friction and they rotate together with the flywheels. Both are encased in cover including the axle. The axle is fixed to the inner rim of ball bearings on both sides near the ends, and the outer rims of the ball bearings fixed to the casing. Fixed to the ends of the axle are driving wheel and delivering wheel which can spin freely almost without fiction, other than the viscosity of water, with the axle concurrently at the same speed. The axle is to connect the driving wheel and the delivering wheel

as one moving part and at the same time keeping the pipeline water and the waste water apart, as the driving wheel will have the flowing water from the pipeline and the delivering side wheel will be driving the waste water from the WT. The fins on the perimeters will be slightly curved, the driving wheel fins receive the dynamic pressure/kinetic energy from the pipeline flowing water with the concave face, for better energy transfer, and the delivering wheel fins drives the waste water with the convex face for better centrifugal force and better discharge of waste water. The two flywheels are acting as one with the driving wheel receives the kinetic energy on the concave side and the delivering wheel with the kinetic energy received drive the waste water on the convex side. The pumping gadget is fixed to the bottom of the WT with the driving wheel on top and the delivering wheel at the bottom; the pipeline water will be connected to inlet at (Fig 5 ref 10), and waste water inlet will be at the entry point at (Fig 7 ref 15), and the outlet of the two waters after combining at the junction (Fig 5 ref 11) will be discharged out of the faucet (Fig 7 ref 14) when it is turned on.

(0039) When the installation is complete, the whole system will be subjected to pipeline static pressure and remain stationary when the faucet is at close. As static pressure is equal in all directions, the flow control at (Fig 7 ref 16) will be blocked as one side is the pipeline pressure which will be invariably higher than the opposite side which is the pressure caused by the weight of the waste water in the WT. Other than pipeline pressure, the system is also exposed to atmospheric pressure on the WT, but it will be off-set by the same atmospheric pressure at the outlet of

the faucet when the faucet is turned on, so it is not considered. Loss of energy due to friction and design of pumping gadget and transformation into sound, heat and vibration are not considered as they are considered negligible in the present context, but consideration will be given to all the aspects and minimize to the lowest, and with frictional factor as the main consideration in the design. The ball bearings installed on the axle and with the outer rim fixed to the casing which allows free spinning of the flywheels, and the fact that the moving parts will not be in contact with the stationary parts as described above, the loss due to friction will be down to minimum.

(0040) When the faucet is turned on, there will be a sudden drop in the static pressure coupled with a sudden increase in the dynamic pressure/kinetic energy and water starts to flow; when entering the driving wheel, the kinetic energy turns into rotational kinetic energy, and through the axle, it drives the delivering wheel concurrently, and the delivering wheel starts to pump the waste water simultaneously with the release of the ball check valve, and the water flows towards junction point (Fig 5 ref 11); the rotational kinetic energy of the pipeline flowing water, no doubt it is flowing in the driving wheel, is in effect driving the delivering wheel through the rotating axle and hence the waste water, which is the result of energy transfer. The transfer will render the kinetic energy in the pipeline flowing water in the driving wheel to reduce all the way to the junction point where it combines with the waste water to flow out of the faucet. Simultaneously, the release of the ball check valve will be assisted by the said reduction in static

pressure and also the gravitational energy of waste water from the WT, which also assists in the driving of the waste water.

(0041) The transfer of the kinetic energy from the driving wheel to the delivering wheel depends on the resistance from the delivering wheel. The driving wheel is driven by the pipeline flowing water, the only source of kinetic energy before considering the gravitational kinetic energy from the flowing water from the WT. The delivering wheel drives the waste water. When the WT is empty there is minimum resistance and the driving wheel and delivering will rotate at maximum speed which is set by the kinetic energy transformed from the static pressure of the pipeline water and the diameter of the incoming tubing, the smaller the diameter of incoming tubing the faster will be the speed of flow of the pipeline water (Bernoulli Theorem). When there is water in the WT, the surface area of the fins of the delivering wheel which will be in contact with the waste water will be the main factor in determining the resistance which is the reaction to the driving wheel's action. But the resistance/reaction is lower than the action and the flywheels rotate with the balanced energy. When the reaction is equal to the action, the flywheels remain stationary. The bigger the surface area, the higher will be the resistance and the amount of energy transferred. The surface area of the fins of the delivering wheel will set the speed at which the two flywheels rotate. Whatever speed envisaged of the water flow, with a set of pipeline pressure and tubing size, the driving wheel will be further slowed down if the surface area of the delivering wheel fins is bigger than that of the driving wheel, which in effect increases the transfer of energy. The higher the energy transfer, the higher will

be the amount of waste water driven out coupled with a corresponding reduction of pipeline water content in the outflow at the faucet, and the total combined amount remains the same as the energy available in the system remains the same (Law of Conservation of Energy), before considering the gravitation kinetic energy from the flow of waste water from the WT which is a plus, and the losses due to the design which will be negligible as explained. The pumping gadget will be able to pump the waste water with substantially the same energy available from the pipeline water source without significant losses; the gravitational kinetic energy from the waste water itself will be a plus to the driving energy. With the bigger size fins on the delivering wheel which increases the energy transfer will give rise to an outflow having higher content of the waste water as compared to a case with fins of same size on both driving and delivering wheels.

(0042) The size of the tubing from the pipeline will be from 3 mm to 6 mm diameter at the entry point, the fins on the driving wheel will be to match the entry tubing, and the fins of the delivering wheel will be 6mm to 10mm (width and height or circular) and the diameter of the outflow of the delivering wheel to match, the diameter of the flywheel will be to suit the size of the WT and it will be between 20 mm to 80 mm. The spacing between fins will follow the area of the fins generally. The fins might be curved a little for better transfer of energy. The length of the axle will be no more than 50 mm. Thickness of material will depend on the strength of materials used. But the dimensions of the pumping gadget in general are flexible to suit function and purpose of the

pumping gadget which may include application where bigger size pumping gadget may be required.

(0043) Direct dispensing of waste water.

When the faucet is regularly used, with the contingency allowed, the waste water should be completely utilized, but depending on the way it is used, direct dispensing of only the waste water may be called for. Or the user may opt for a simpler design without dispensing through the sink faucet as the waste water salvaged is in fact cleaner as explained above. A faucet is provided under the WT for direct dispensing. The water will be purely from the WT. The faucet can be swiveled in and out and it is kept in in–position when not in use. The opening and closing is by way of a normal opening and closing device for a faucet (Fig 2 ref 3). Alternatively, there can be another connection for such dispensing through tubing to the sink with another faucet if installation position is away from the sink.

(0044) Provisions for emergency stoppage

(0045) In an unexpected situation where the allowance for contingency is utilized to the maximum, the WT has a provision to prevent overflow from happening. Right at the top of the WT is a small circular extension (Fig1 ref 2, Fig 3 ref 5). Within the circular extension, with dimension to suit requirement, at the bottom of the extension is a weighted float. On top of the weighted float is a miniature gate valve (Fig 3 ref 6, ref 7) that moves upward and downward following the movement of the weighted float. The water supply line to the filtration system passes through the top part of the extension (Fig 4 ref 8) and the miniature gate valve.

(Fig 4 ref 9) is connection to drainage for equipment failure. The miniature gate valve stands vertically upward and is set at open position when it is installed, the weighted float rest on supports from the perimeter of the extension at the bottom most. When the WT is full, including the contingency allowance, any further filtration will force the waste water to flow through the extension, and the up-thrust will push the weighted float upward and close the water supply to the AST RO filtration system and thereby stopping the filtration process. It happens automatically. The movement will be only few millimeters which is the tubing size. The cutting off of the water supply is at a point before the supply reaches the RO system. It is separate from the connection to the faucet. The miniature gate valve on weighted float will remain open all the times until over usage happen,

(0046) Course of action for reviving the filtration system after the emergency stoppage is activated will be usage of water from WT by opening the direct dispensing faucet as described in (0043) above until the water level drops together with the weighted float and miniature gate valve where it returns to open position with the weighted float back seated on the protrusions/supports as described. It should take only seconds before the valve returns to open position as the volume of the extension is small (Fig 3). If regular further usage of supply is continued, it will put the system back to normal operation and there is no need to purposely dispense the water from the direct faucet as described above. Any seepage from the valve will be drained into the WT which will be salvaged for usage. An indication is provided for such stoppage when happened with the top part of the gate valve in

white (Fig 3 ref 7) and will be exposed to view when the supply is closed.

(0047) WT for existing RO system

The WT can be installed with an existing RO system adopting a pressure tank. The issue is that the volume of the WT will have to be bigger as there is more waste water now. The shape and size of WT can be flexible to suit space available. Where there is no space constraint issue, the size of the WT can be increased, or where there is additional space under the sink or outside the sink, extension tank can be used to increase storage capacity. But the extension tank has to be taller than the main tank inclusive of the protrusion if they are installed at the same level and there will not be pumping gadget and miniature gate valve on weighted float in the extension tank as they are not required. The extension tank must also be exposed to atmospheric pressure and the effective height must be taller than the main WT inclusive of the extension regardless of the level of installation. The functions of the pumping gadget, emergency stoppage with indication are the same as in WT for AST RO system. The direct dispense of the waste water from the WT by the direct faucet under is probably no more required as the WT would likely be placed under sink. In terms of salvaging the waste water for usage, it can achieve the same purpose, except that the emergency stoppage might be activated too frequently during usage, theoretically.

(0048) When installed with an existing RO system, installation will be to connect the discharge of the waste water from the RO system to the WT; the connection to the faucet will have to pass

through the pumping gadget for pumping of waste water, and the connection to the RO filtration system will have to pass through the miniature gate valve on weighted float for the emergency stoppage all as before described

Claims

1 The “Waste Water Tank for Zero Waste” is a component (Fig 1 ref 1 Fig 2) designed to be part of a point of use AST RO system, which can also be used on an existing RO system, comprising of an atmospheric water tank with contingency allowance in volume for salvaging and storing of waste water produced during the filtration, two outlet provisions for dispensing the waste water stored, one through the existing sink faucet the WT is connected to with a pumping gadget with flow control section (Fig 5, Fig 7 ref 16), for pumping of waste water combined with pipeline water for usage, and the other through a faucet for direct dispensing of the waste water only in the WT (Fig1, Fig 2 ref 3) for usage, and a miniature gate valve on a weighted float (Fig 3 ref 6 ref 7) for cutting off the water supply automatically in the event of over usage together with an indication for such incident when happened; on completion of installation, can salvage the waste water in the WT for usage when either of the faucets is turned on, one making use of the kinetic energy in the flowing water from the pipeline and the gravitational kinetic energy of the flowing waste water from the WT, with the waters combined, through the sink faucet, and or second, making use of the gravitational kinetic energy of the flowing waste water from the WT through the direct dispensing faucet, with only waste water, to achieve the target of zero waste when an AST R0 system is adopted, and to achieve partial salvage when installed with an existing RO system, with the emergency cutting off of the water supply on standby which will be activated automatically when over usage of filtered water happen.

2 The target of zero waste AST RO system cited in claim 1 is achieved with the WT having a contingency allowance in storage volume and coupled with regular usage of the waste water through the direct dispensing faucet, and or through the sink faucet with the pumping gadget combining the pipeline water and waste water, safeguarded by the provision of emergency cutting off of the water supply to limit over usage by the gate valve on weighted float remains on standby position which will be activated automatically when over usage happens.

3 The contingency allowance for the storage volume of the WT cited in claim 1 is for use with the AST RO system, and it is added-on to the volume based on the actual estimation of the volume of waste water that will be produced during filtration with a set of pipeline pressure, membranes and filtration materials adopted.

4 The cutting off of the water supply cited in Claim 1 relies on a miniature gate valve on weighted float on top of the WT (Fig 1 ref 2, Fig 3, Fig 4), encased in a circular protrusion with dimension to suit requirement, at the centre of the protrusion is the miniature gate valve with water supply to the AST RO system passing through it; the weighted float is supported by the protrusions from the base which is the lowest position at open; this remains when the contingency limit is not utilized and the gate valve on weighted float remains on standby position; when over usage of filtered water happens, the up-thrust of waste water will push the weighted float upward through the extension and the miniature gate valve will automatically close the water supply to the AST RO system, and with the white color top part of the gate valve

exposed to view to indicate close position; once the usage of *waste water on the WT continues, either through the direct* dispensing faucet or the existing sink faucet, the water level will be lowered and at the same time causes the weighted float with the miniature gate valve to be lowered and back seated on the protrusions to open the water supply and revive the filtration system in seconds.

5 The pumping gadget (Fig 5) cited in Claim 1, with dimension to suit requirement, has two miniature flywheels of the same diameter, one driving wheel (Fig 5 ref 12 section B-B Fig 6) and the other delivering wheel (Fig 5 ref 13,section C-C Fig 7) and they are connected by a common axle rigidly (Fig 6, Fig 7 ref 17), meaning they will rotate as one and will rotate concurrently at same speed when force is applied to the driving wheel; on the perimeter of the flywheels are fins with size to match the flow, with the delivering wheel having bigger size fins than the driving wheel, on the sides of the flywheels are two covering plates which are fixed to the sides of the fins; and they are separated from the surface of the cover and they rotate together with the flywheels; both are encased in cover including the axle; the axle is fixed to the inner rim of ball bearings on both sides near the ends, and the outer rims of the ball bearings fixed to the casing; fixed to the ends of the axle are driving wheel and delivering wheel which can spin freely with the axle, almost without friction other than that caused by viscosity of water, concurrently at the same speed; the axle is to keep the pipeline water and the waste water apart, as the driving wheel will have the flowing water from the pipeline and the delivering wheel will be driving the waste water from the WT;

the fins will be slightly curved, the driving wheel fins receive the kinetic energy from the pipeline flowing water with the concave face, and the delivering wheel fins with the energy received drives the waste water with the convex face, rotating in the same direction owing to the balanced energy from the kinetic energy from the driving wheel when the faucet it is connected to is turned on; the kinetic energy on the delivering wheel will be increased by the additional gravitational kinetic energy from the flowing waste water from the WT when the ball valve in the flow control section is unblocked; the pumping gadget is fixed to the bottom of the WT with the driving wheel on top and the delivering wheel at the bottom; the pipeline water will be connected to inlet at (Fig 5 ref 10), and waste water inlet will be connected to entry point at (Fig 7 ref 15), and the outlet of the two waters after combining at the junction (Fig 5 ref 11) will be discharged out of the pumping gadget (Fig 5 ref 14) when the faucet is turned on.

6 The pumping gadget cited in claim1 will remain stationery on completion of installation, when the sink faucet it is connected to is turned on, there is an immediate drop in static pressure and an increase in the kinetic energy in the pipeline flowing water which drives the driving wheel and concurrently the delivering wheel together with the gravitational kinetic energy from the waste water upon release of the ball check valve assisted by the reduction in static pressure, all happening simultaneously, will drive and deliver the waste water in the WT combining with the pipeline water and flow out of the faucet for usage, with approximately the same amount of energy from the pipeline water source if not

higher due to the presence of additional gravitational kinetic energy from the flowing waste water from the WT.

7 The pumping gadget cited in claim 1 will have higher amount of energy transfer from the driving wheel to the delivering wheel with bigger size fins on the delivering wheel than that of the driving wheel, as compared to one having same size fins on both wheels, and will give rise to a higher percentage of waste water at the exit of the faucet coupled with a corresponding reduction in the amount of pipeline water.

8 The direct dispensing faucet cited in claim1 is under the WT for direct dispensing of the waste water when installation level is above existing faucet level, it can be kept in in-position when not in use and swiveled out for usage when required and with normal opening and closing device usually found on a faucet; and or, can be through tubing to the sink with another faucet for usage when installation is away from the sink.

9 The WT cited in claim 1 can be installed together with the AST and the filtration system at one location, at the sink or away from the sink, or can be installed together with the AST but away from the filtration system installed at the same level.

10 The WT cited in claim 1 can be installed with an existing RO system adopting the pressure tank system; installation will be to connect the discharge of the waste water to the WT; the connection to the faucet will have to pass through the pumping gadget for pumping of waste water; the connection to the filtration will have to pass through the miniature gate valve on weighted

float for emergency stoppage; extension tanks may be used to increase storage capacity where available space allows.