PRODUCT DESIGN IMPROVEMENT OF WATER DISPENSER TAP USING TRIZ METHOD

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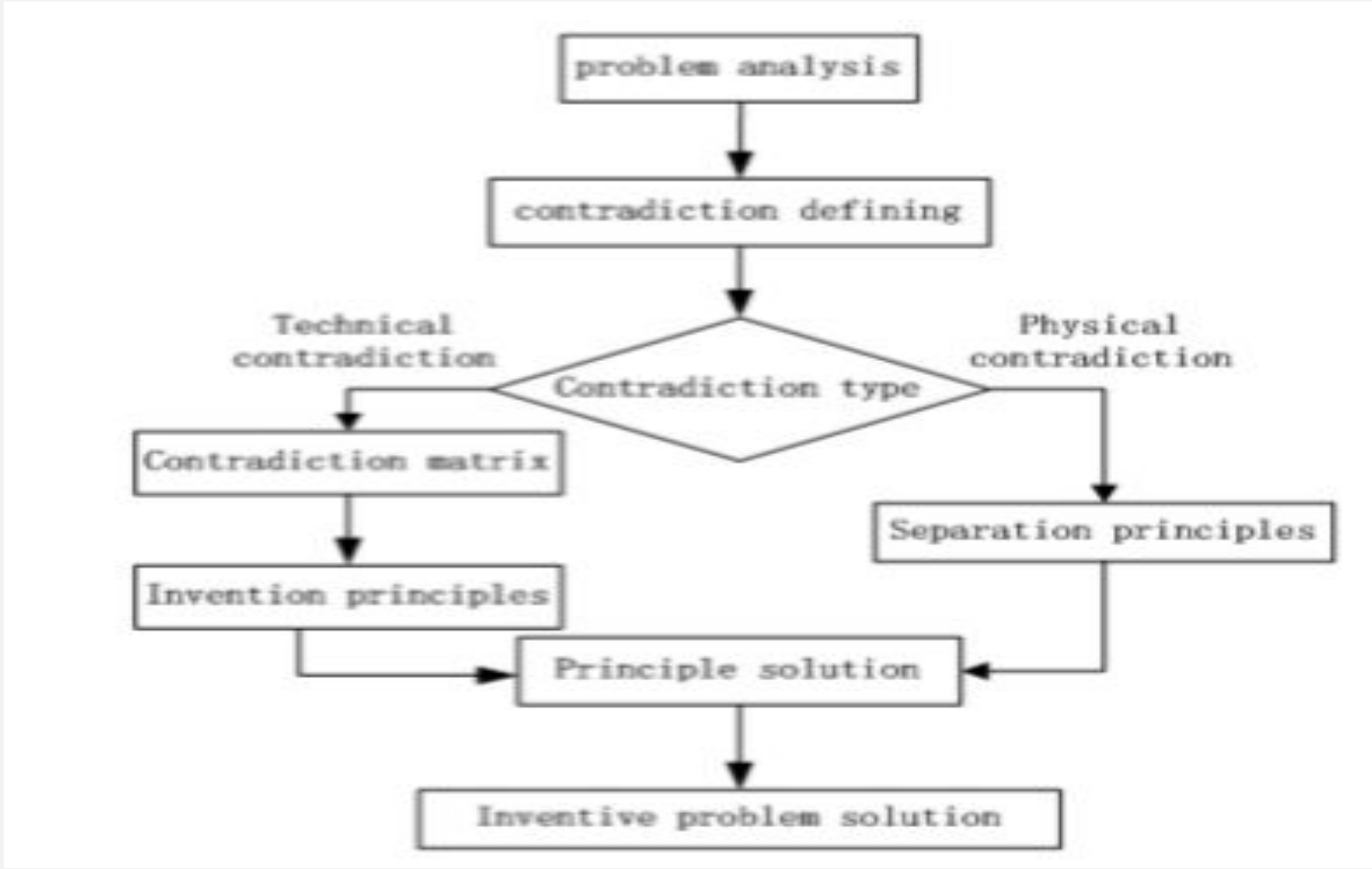
RESEARCH METHODOLOGY

THEORY OF INVENTIVE PROBLEM SOLVING(TRIZ)

TRIZ METHOD

- TRIZ theory is a new method of creative design which provides systematic theory and tools for inventive problem discovering and solving . TRIZ (The Theory of Inventive Problem Solving provides systematic methods and tools to solve product contradiction.
- System contradiction is a core concept in TRIZ and it means the hidden inherent contradictions behind the problem.
- TRIZ divides the contradictions into three categories: technical contradiction, physical contradiction and administrative contradiction. Technical and physical contradictions are the cornerstones of TRIZ. The formulation of these two contradiction aids in understanding the root of a problem better and discovering the exact solution for the problem faster.


problem analysis
contradiction defining
Technical contradiction
Contradiction type
Physical contradiction
Contradiction matrix
Separation principles
Invention principles
Principle solution
Inventive problem solution

PHYSICAL CONTRADICTIONS

- Physical contradiction occurs also if: the intensification of the useful function in a subsystem causes the simultaneously intensification of the existing harmful function in the same key subsystem, or the reduction of the harmful function in a subsystem causes the simultaneously reduction of the useful function in the same key subsystems.
- When dealing with a known physical contradiction, one of the four principles for overcoming this type of contradiction can be used.

(1) Separation in time.

(2) Separation in space.

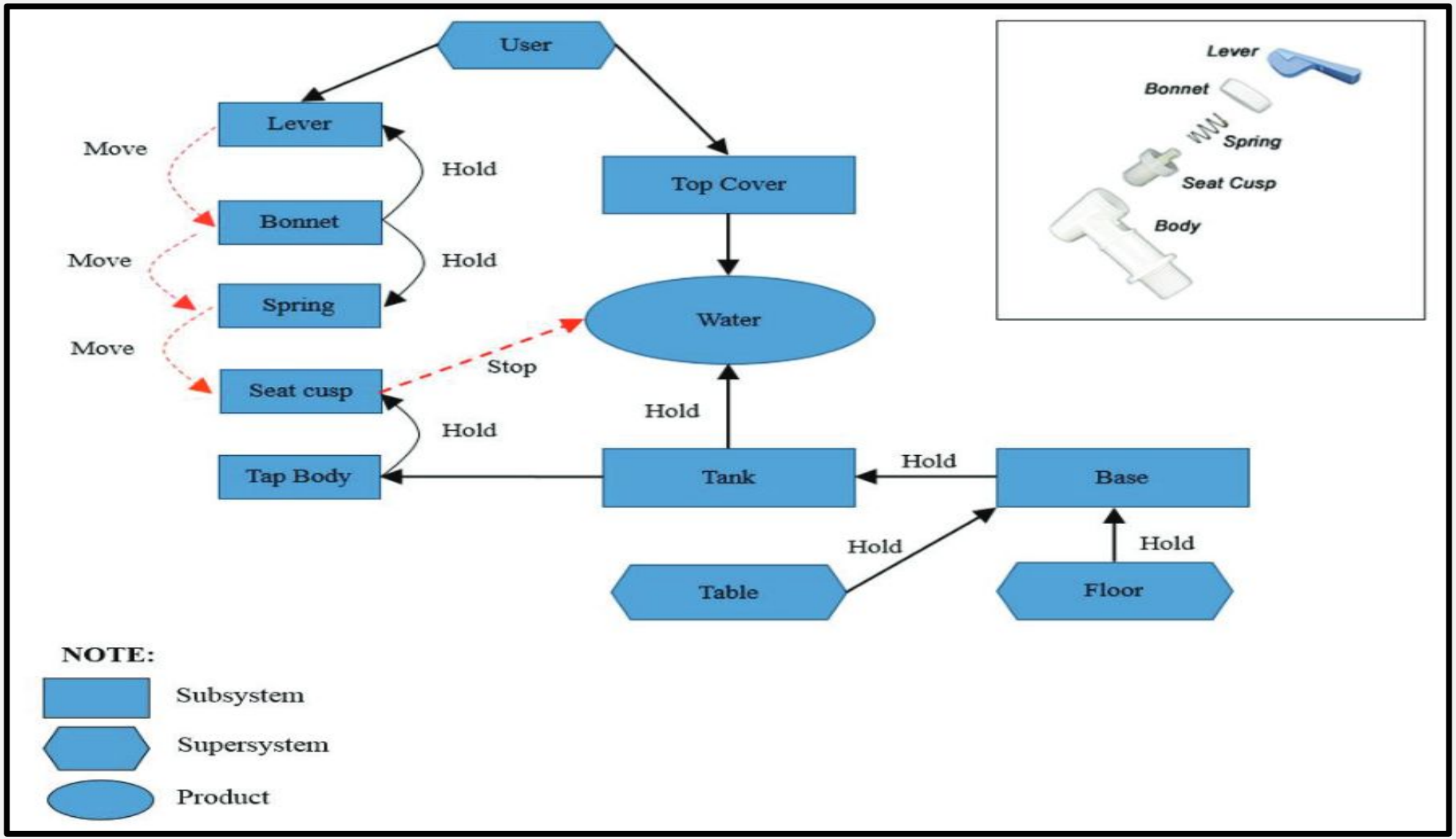
(3) Separation between the whole system and its parts.

(4) Separation based on different conditions.

ROOT CAUSE IDENTIFICATION USING FUNCTIONAL MODEL

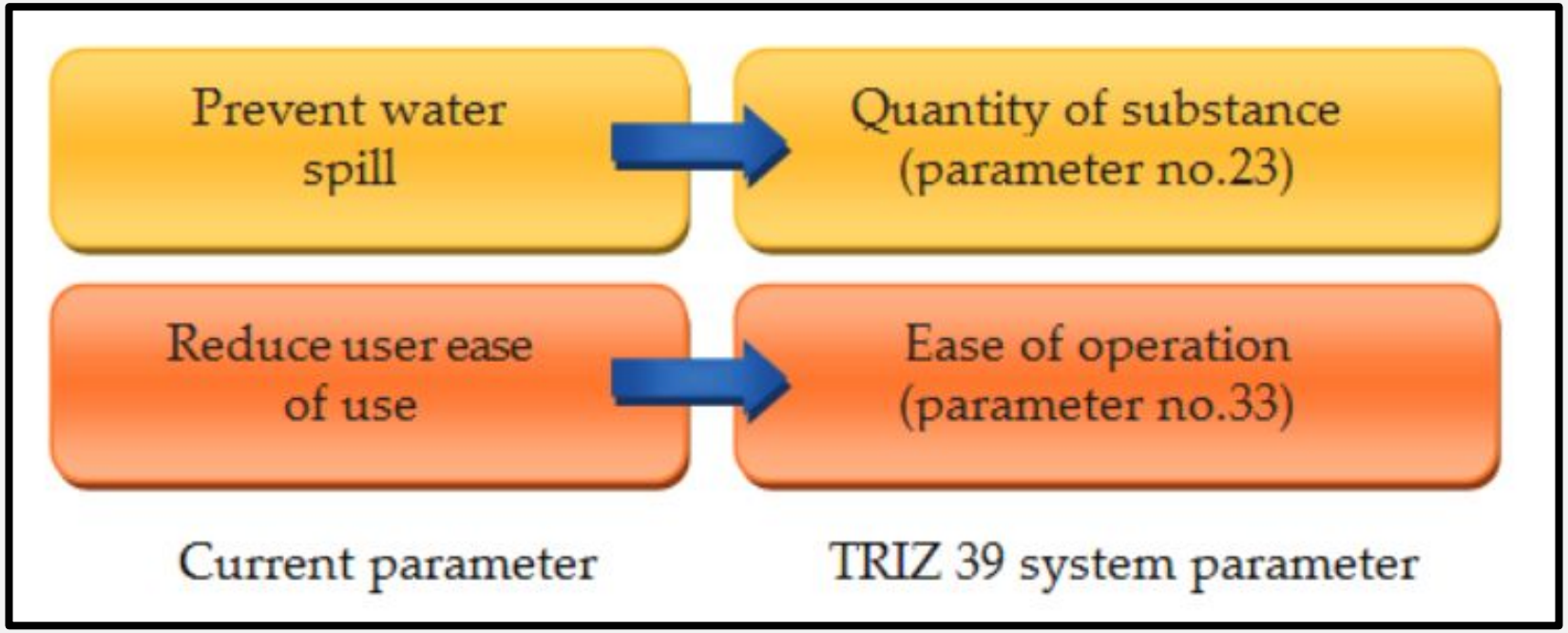
Function type	Line style
Useful (normal)	
Useful (insufficient)	
Useful (excessive)	
Harmful	

FUNCTIONAL MODEL DIAGRAM FOR WATER DISPENSER TAP ASSEMBLY



MODELING THE PROBLEM USING ENGINEERING CONTRADICTION

- Problem statement :
- "*If the nozzle pointing upwards, then it will prevent water spill but reduce user convenience (ease of use to the user) as well as reducing water flow process*"



IDENTIFY GENERAL SOLUTION USING CONTRADICTION MATRIX AND 40 INVENTING PRINCIPLES

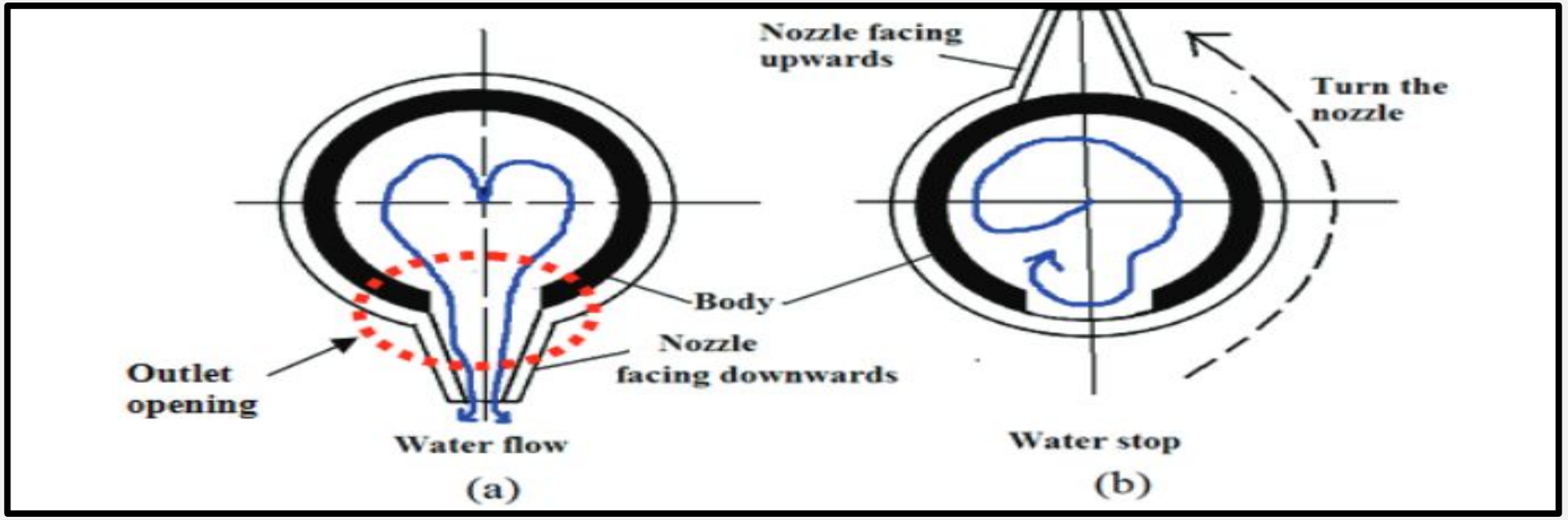
Parameter to improve	Worsen parameter	Recommended TRIZ 40 inventive principles and descriptions
No. 23: Quantity of substance	No. 33: Ease of operation	**No.32: Colour changes** a) change the colour of an object or its external environment. b) change the transparency of an object or its external environment.
		No.28: Mechanics substitution a) replace a mechanical means with a sensory (optical, acoustic, taste or smell) means. b) use electric, magnetic and electromagnetic fields to interact with the object. c) change from static to movable field-activated (e.g ferromagnetic) particles.
		No.2: Taking out a) separate the interfering part or property from an object, or single out the only necessary part (or property) of an object
		No.24: Intermediary a) use an intermediary carrier article or intermediary process. b) merge one object temporarily with another (which can be easily removed).

PRODUCT DESIGN IMPROVEMENT OF WATER DISPENSER TAP

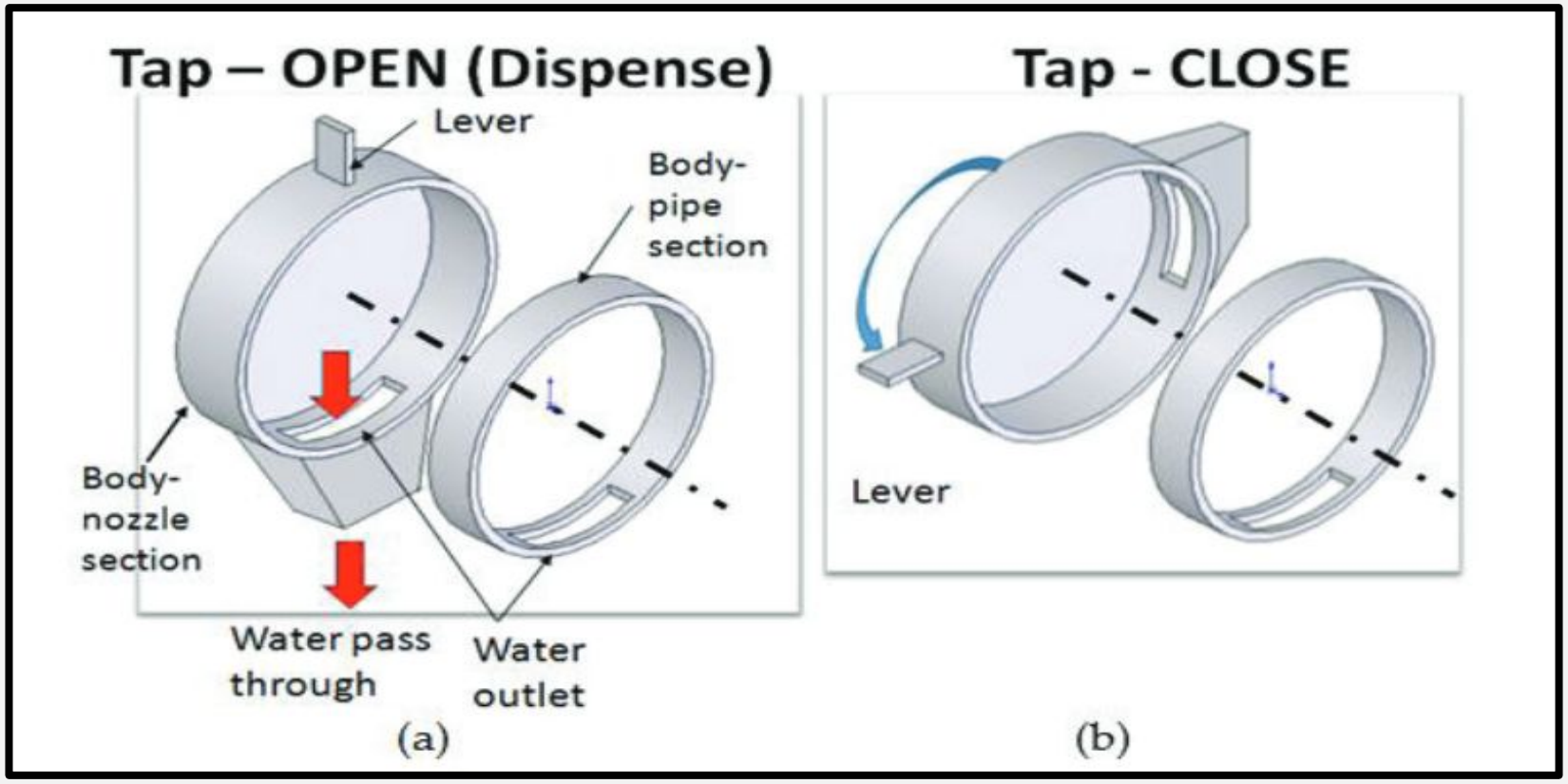
- "TAKING OUT"
- The phrase can be interpreted as to remove un-necessary subcomponents ,leaving only important subcomponents to enable task of stopping and dispensing water.
- Next process is to create a dual functioning body component which can operate to stop the water.

MECHANISM FOR NEW WATER DISPENSING TAPS

- A) both body and nozzle are aligned and permit the water flow
- B) the nozzle turned upwards to stop flowing water ; it was harder for excess water to flow out gravitationally.



CAD MODEL OF NEW WATER DISPENSER TAP



ADVANTAGES OF NEW TAP DESIGN OVER EXISTING DESIGN

- Multifunction capability
- Quick and simple open-close mechanism
- Reduced 60% of existing number of child parts (only 2 parts from initially 5 components)
- Potentially lowered overall cost

WATER SAVING IN TOILET BOWLS

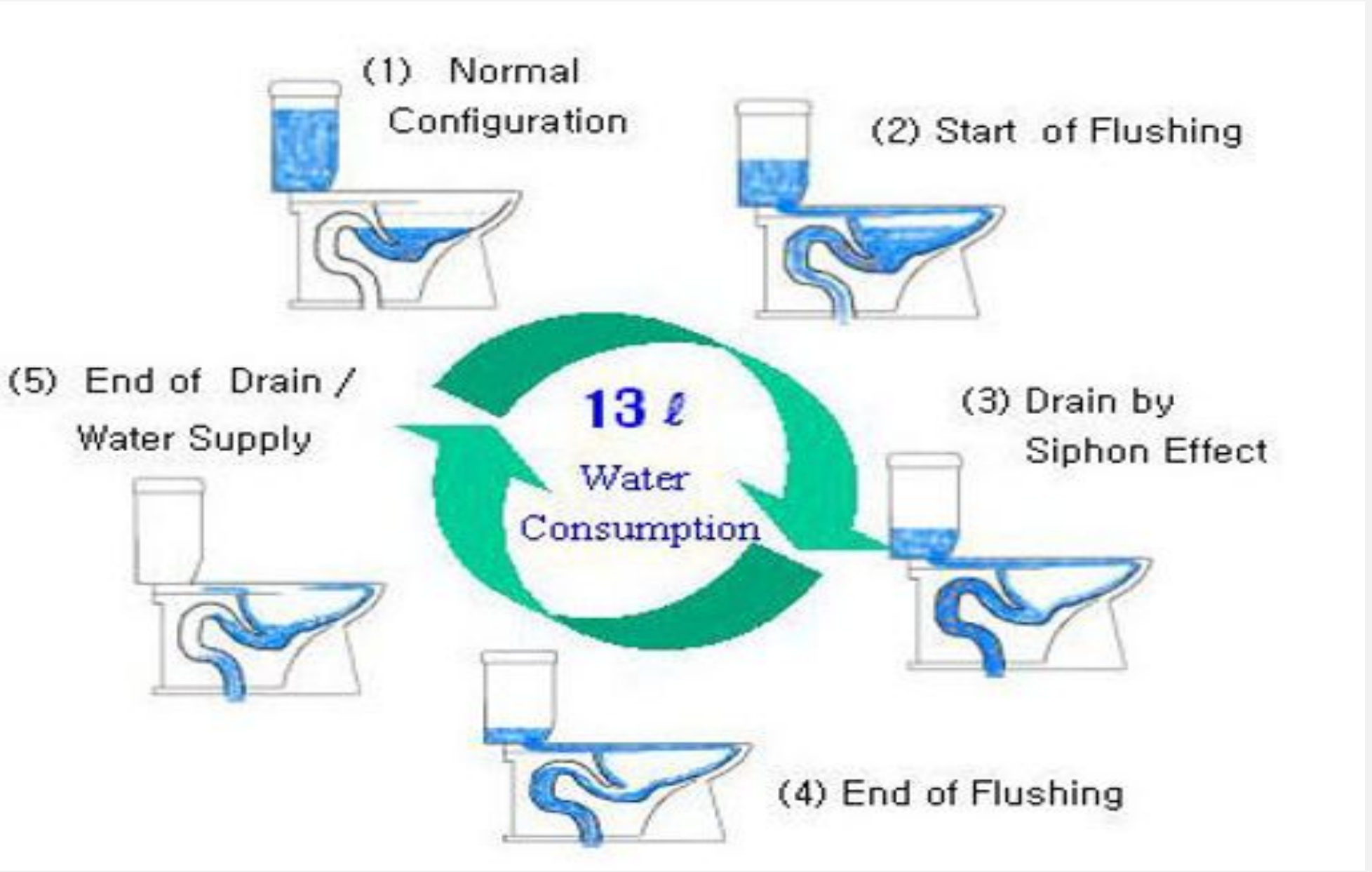
- *Due to excess usage of water in world and due to **Global warming** and **Irregular rains** , there arise a new problem of water shortage in every country.*
- *To achieve the dramatic reduction of water consumption, it is necessary to develop the water-saving technologies and activate the relevant industries. Specifically Water usage in flushing bowl is purpose of flushing in toilet is nearly **27% in home** and more than **50% in commercial buildings** which is very high.*

DEFINING PROCESS AND PROBLEMS

- *As you know, the toilet bowl uses considerable amount of water ,the conventional toilet bowel uses 13 L of water for one time use.*
- *Most people insert bricks to its water tank in order to save water.*
- *But :- A) volume of water saved by such measure is just one liter.*
- *B) such insertion may result in poor flushing effect.*
- *There are suction or foam washable toilets mainly used in trains or airplanes. These toilets require a separate power supply and a chemical agent, so they are not suitable for home use.*

DEFINING PROCESS AND PROBLEMS

- *Toilet bowl consumes about 13 L of water for one time use. The toilet bowl looks clean and has the advantage of preventing bad smells from the septic tank because its water tank is always filled with water. Such advantage is further realized by employing an* ***S-shaped*** *trap containing water in bowl.*
- *However, considerable amount of water is required to make the stool go through such trap with height.*


(1) Normal Configuration
(2) Start of Flushing
(3) Drain by Siphon Effect
(4) End of Flushing
(5) End of Drain / Water Supply
13 ℓ
Water Consumption

COMPARING CUSTOMERS NEED WITH S TYPE SYSTEM

- When the manufacturer and salesman investigate the customer's needs of toilet system, the followings are listed mainly;

1. Removing the stool
2. Flushing bowl
3. Preventing bad smells from septic tank
4. Saving water for flushing recently in water-shortage era
5. reducing noise when flushing

COMPARING CUSTOMERS NEED WITH S TYPE SYSTEM

- For Customer's needs

1. Removing the stool	disappearance	
2. Flushing bowl	disappearance	
3. Preventing bad smells from septic tank	appearance	by water in bowl
4. Saving water for flushing	disappearance	
5. reducing noise when flushing	disappearance	

DEFINING PHYSICAL CONSTRAINS IN WATER DRAINAGE SYSTEM

- TRIZ requires that the problem should be described and defined in a simple and plain sentence.
  S -trap structure is the parameter of physical contradiction in TRIZ. The physical contradiction is generated when different needs have to be satisfied at the same time.
- Most ideal method? The "S" shaped trap is required to prevent bad smells from the septic tank, but this structure has to be removed when flushing the stool in order to save the water. In other words, the trap structure has **to appear and disappear**. So physical constrain is defined as

"The trap structure is required to prevent bad smells and it has to be removed to flush the stool with less water."

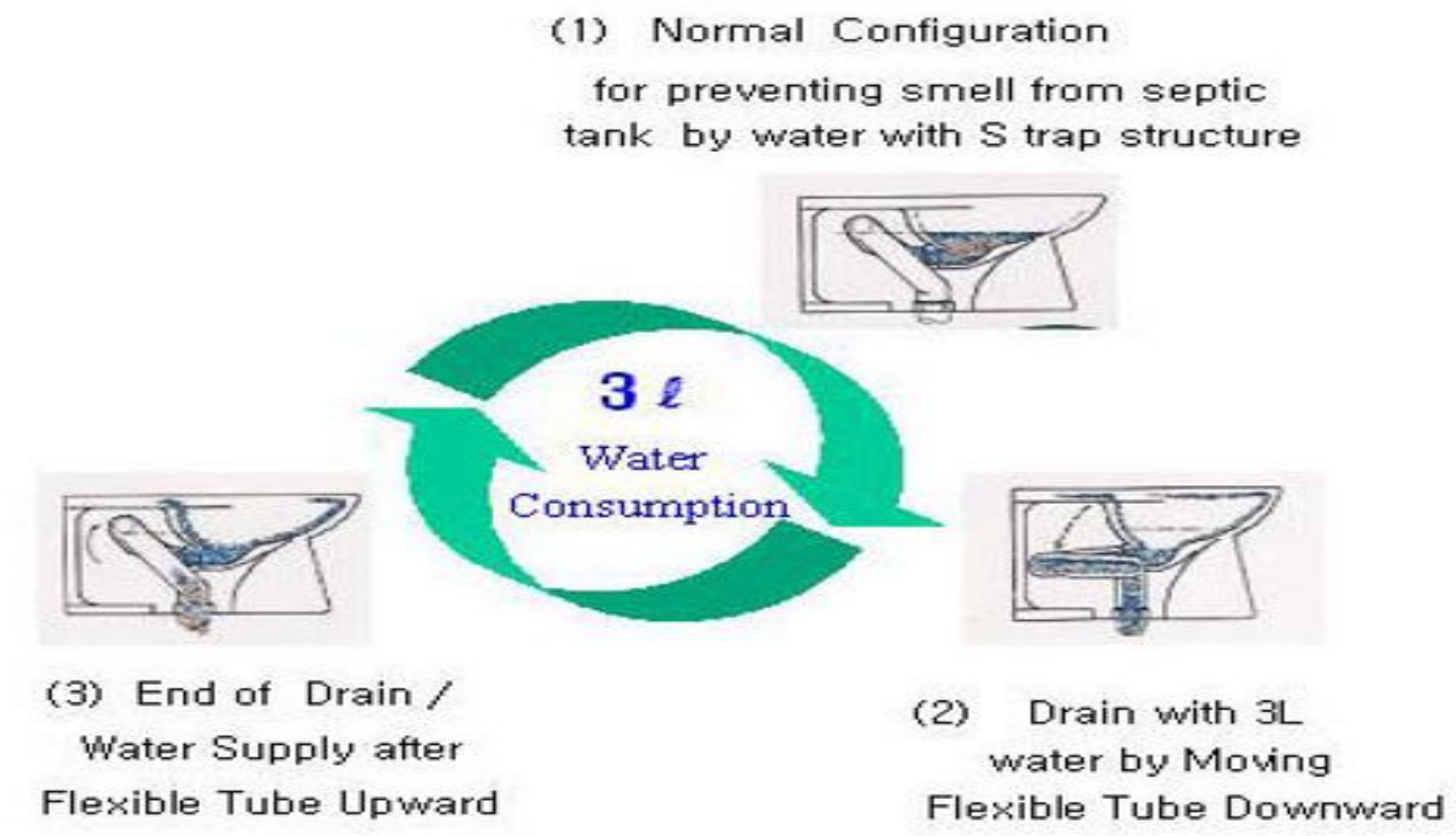
SOLUTION METHOD

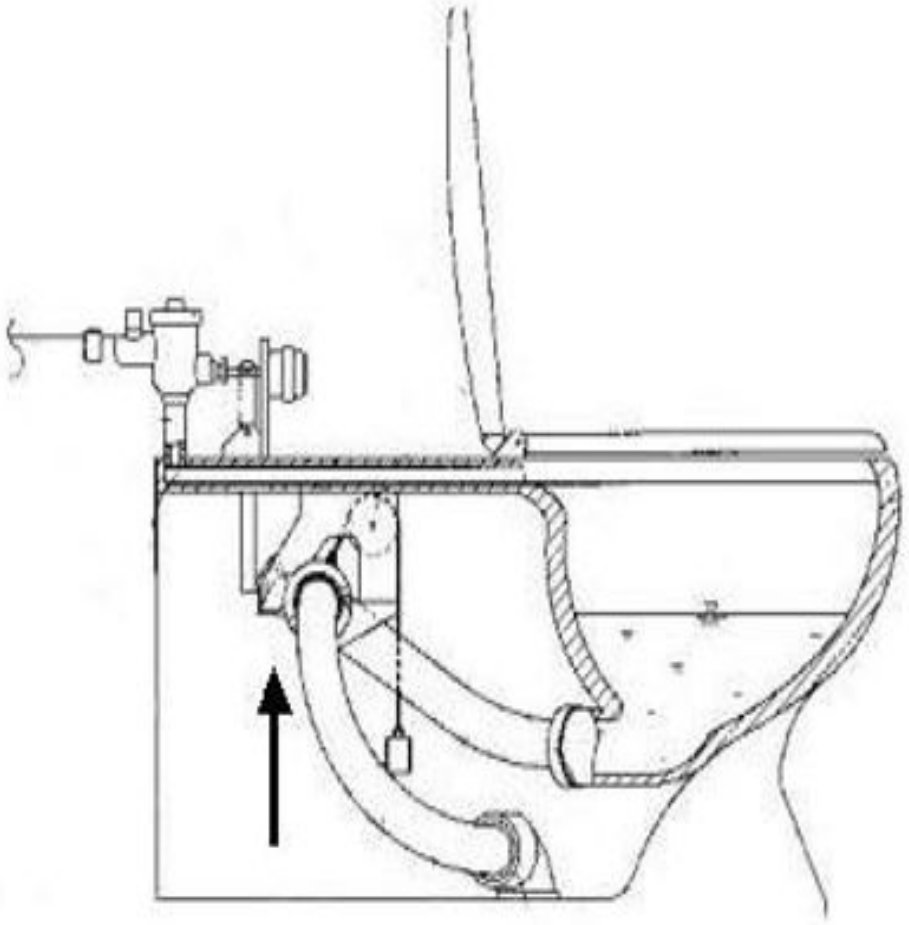
- The toilet bowl's drain outlet has a trap structure, but it loses such structure when flushing the stool. Once the flushing is completed, it recovers the trap structure again. In this way, the physical contradiction can be overcome by time-based separation, which provides a clue to solve the present problem.
- "Modeling with Miniature Dwarfs (MMD)", This technology allows us to imagine dwarfs working themselves without the use of additional devices(Electric Motor).
  The weight of water removes the flexible tube downward and then, a simple mechanical component, such as spring or plummet, helps the flexible tube return to its original position upward.

- The Water Consumption gets reduce to 3L.

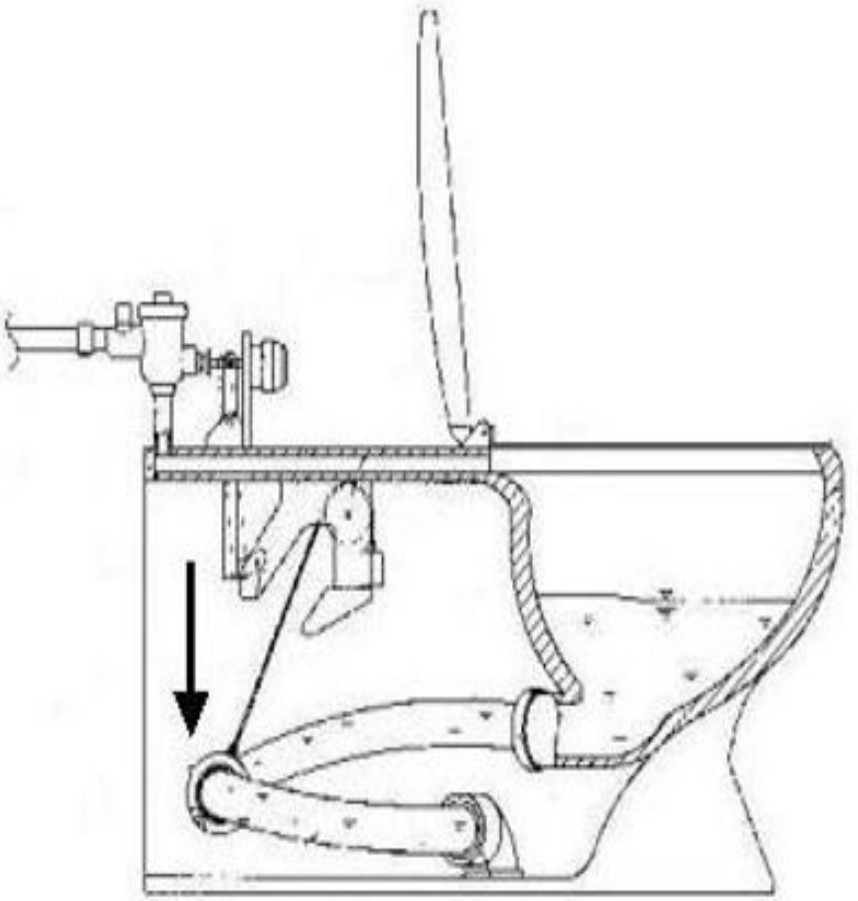
2.5 L → Always remain in bowl (avoid bad smell)

0.5 L → Flushing purpose





(a) Normal: Up Configuration of the Tube



(b) Drain: Down Configuration of the Tube

OTHER ADVANTAGES

- REDUCE NOISE- According to Japanese company method test was conducted at night to find out that Conventional method made 70db noise while new method made 60db noise during flushing.
- ACID RESISTANCE-The flexible tube coming into contact with the stool and water was soaked in hydrochloric acid, a bleaching agent, and a detergent used in clearing the plugged tube for 6 months to determine the flexible tube's mechanical and physical properties. Except some bleaching by a bleaching agent, the flexible tube did not show any change of its physical properties.
- DURABILITY-After performing durability test on new method it was found out that it is durable for minimum of 20 yrs.