CHAPTER I

INTRODUCTION

Management is the process of coordinating people and other resources to achieve the goals of the organization. Management in business and organizations means to coordinate the efforts of people to accomplish goals and objectives using available resources efficiently and effectively. Management comprises planning, organizing, staffing, leading/directing, and controlling an organization or initiative to accomplish a goal. Resourcing encompasses the deployment and manipulation of human resources, financial resources, technological resources, and natural resources.

Competition for water is intensifying. The urge to cater for basic human needs, together with demands for general improvements in standards of living and continued economic growth, has resulted in a rapid increase in the pressure on available water resources. Lowered water tables, reduced natural flows, steadily more complex pollution and quality problems, natural occurrence of arsenic and fluoride, etc., tremendously affect people's access to water for sustenance as well as the agricultural sector's needs and conditions in the ecosystems.
Demographic trends of increasing population density, migration and urbanisation add to the picture, changing the patterns of competition for freshwater (Lyla Mehta, 2014).

An estimated almost 1.2 billion people worldwide lack access to safe drinking water. The less-developed regions of the world are particularly vulnerable to increasing water scarcity, and the areas which are at risk due to climate change have become a matter for the United Nations (UN) Security Council. Efforts to build up and disseminate greater knowledge about how man-made climate change will affect such things as access to freshwater have, in line with this, been rewarded with the Nobel Peace Prize. Access is increasingly a question of linking scientific knowledge and forecasts with value-based principles such as precaution, morals, dignity – and law. All these aspects are of importance for effective regulation and control, and for.

1.1 THE CONCEPTIONS OF ‘ACCESS’ AND ‘SCARCITY’

The connection between poverty-alleviation, development and access to water has for several decades been stressed both by the scientific community and among policymakers. The Human Development Report of the United Nations Development Program (UNDP), 2006, had water as its focus. The point of departure was unambiguous: “For some, the global water crisis is about absolute
shortages of physical supply. This Report rejects this view. It argues that the roots of the crisis in water can be traced to poverty, inequality and unequal power relationships, as well as flawed water management policies that exacerbate scarcity”. This UNDP Report thus held that inadequate access to water is a deficit rooted not in physical (UN) availability, but in political choice and governance. What is meant by ‘access to water’? The notion refers to access to safe drinking water and is mostly understood as that developed by the World Health Organization (WHO) and the United Nations Children’s Fund (UNICEF). There are several definitions, though, including different estimations of the quantitative requirements (ranging from three to fifty litres per capita and day, lpcd). This is to cover not only the needs of water for drinking, but also for preparing food at home, as well as basic health protection. ‘Access’ is here normally distinguished from the notion of ‘consumption’. The definition of ‘safe’ water relates both to the water source and/or technology as being ‘improved’, based on certain criteria, and to such aspects as physical accessibility (Howard, et.al. 2003).
1.2 MAIN CHALLENGES IN WATER REQUIREMENTS

Although most countries give first priority to satisfaction of basic human needs for water, one fifth of the world’s population is without access to safe drinking water and half of the population is without access to adequate sanitation. These service deficiencies primarily affect the poorest segments of the population in developing countries. In these countries, water supply and sanitation for urban and rural areas represents one of the most serious challenges in the years ahead. Water is increasingly seen as a key constraint on food production, on a par with, if not more crucial than, land scarcity. All human activities need water and produce waste, but some of them need more water or produce more waste per job than others. This consideration has to be taken into account in economic development strategies, especially in regions with scarce water resources. Water has a value as an economic good. Many past failures in water resources management are attributable to the fact that water has been – and is still – viewed as a free good, or at least that the full value of water has not been recognized. In order to extract the maximum benefits from the available water resources there is a need to change perceptions about water values and to recognize the opportunity costs involved in current allocate patterns (GWP-TAC, 2000).
1.3 RESEARCH AND DEVELOPMENT IN WATER RESOURCE MANAGEMENT TECHNOLOGY

Technological innovation and adaptation are key components of many efforts within the water sector. At the conceptual level models and forecasting systems are being improved, particularly as a result of advances in computer technology, to allow better predictions of temporal and spatial variations in the quantity and quality of available water resources. This may help to reduce uncertainties and risks in the use and management of the resources.

Water saving technologies in irrigation (e.g. drip irrigation), improved and cost-effective methods for the treatment and reuse of wastewater in industries and domestic systems, aquifer recharge technologies, human waste disposal systems that require no or extremely small quantities of water, and cheap but effective water purification systems for villages are other examples of promising innovations which can promote the sustainability of future water resources (Scott D. Struck, et.al. 2009). However, achieving such technological advances requires both appropriate incentives and the willingness of more wealthy countries, particularly the more wealthy industrialized nations, to invest in research with a long-term return.
1.4 IMPORTANCE OF WATER PURIFICATION

Our body depends upon what one drink. The EPA released to the news media Dec.14, 1988 information that stated there is some kind of toxic substance in our ground water no matter where we live. We have all heard some reference to problems resident in our drinking water in past decades. Even materials added to our drinking water to "protect" us (such as chlorine) are linked to certain cancers, and can form toxic compounds (THM's) which adversely affect us. The old adage "If you want something done, do it yourself' applies to our drinking water also. The most sensible solution to pollution is a point of use water purification device. Point of use refers to the tap, which is the location from which we draw our water. The tap is the end of the road for water which is consumed by us, or our family. There are no more pipes or conduits which can leach elements into our drinking water beyond this point (Naturally Pure Alternatives, 2014).

Recent studies show that many brands of bottled water contain high levels of contaminants. Surveys reveal that most of what is promoted as pure is just municipal water that has been re filtered and repackaged with slick labelling. If you do drink bottled water regularly, make sure that the bottle is properly sealed opened
in front of your eyes crushed and properly disposed of to avoid reuse and adulteration (bottles are made up of PVC).

1.5 IMPLEMENTATION OF WATER RESOURCE MANAGEMENT

Populations under Water Stress

The world population has increased by a factor of about three during the 20th century whereas water withdrawals have increased by a factor of about seven. It is estimated that currently one third of the world’s population live in countries that experience medium to high water stress. This ratio is expected to grow to two thirds by 2025 (Peter H. Gleick, 2000)

The Impact of Pollution

Pollution of water is inherently connected with human activities. In addition to serving the basic requirement of biotic life and industrial processes, water also acts as a sink and transport mechanism for domestic, agricultural and industrial waste causing pollution. Deteriorating water quality caused by pollution influences water usability downstream, threatens human health and the functioning of aquatic ecosystems so reducing effective availability and increasing competition for water of adequate quality.
Securing Water for People

These service deficiencies primarily affect the poorest segments of the population in developing countries. In these countries, water supply and sanitation for urban and rural areas represents one of the most serious challenges in the years ahead.

Securing Water for Food Production

Population projections indicate that over the next 25 years food will be required for another two-three billion people. Water is increasingly seen as a key constraint on food production, on a par with, if not more crucial than, land scarcity. Irrigated agriculture is already responsible for more than 70 percentage of all water withdrawals (more than 90% of all consumptive use of water). Even with an estimated need for an additional 15 – 20 percentage of irrigation water over the next 25 years - which is probably on the low side – serious conflicts are likely to arise between water for irrigated agriculture and water for other human and ecosystem uses. Difficulties will be exacerbated if individual water-short countries strive for food self-sufficiency rather than achieving food security through trade; by importing food countries can in effect import water from more generously endowed areas (the concept of “virtual water” (GWP-TAC, 2000).
1.6 MANAGEMENT OF WATER RESOURCES

The Management of Water is a global concern and particularly in India. In India Millions do not have enough water, particularly during summer months, and women and girls have to walk long distances to fetch water. In the search for water, people are going deeper into the ground, lowering the groundwater table and leaving wells dry. The per capita availability of water for India in 2001 is expected to be half its 1947 level. Poor sanitation and unsafe drinking water account for a substantial part of the disease burden in India, contributing to diarrhoea, dysentery, typhoid, worms, jaundice and cholera. Each drought destroys the abilities of rural communities to cope. It makes them weaker and more disabled to deal with the vagaries of the monsoon. And in that way drought becomes permanent and long lasting and eats away at the very insides of the country (Human Development Report, 2006).

Challenges faced by more and more countries in their struggle for economic and social development are increasingly related to water. Water shortages, quality deterioration and flood impacts are among the problems which require greater attention and action (AlkaUpadhyay, et. al. 2013). The world population has increased by a factor of about three during the 20th century whereas water withdrawals have increased by
a factor of about seven. It is estimated that currently one third of the world’s population live in countries that experience medium to high water stress. This ratio is expected to grow to two thirds by 2025. The more time and effort spent on these problems today, the greater will be the reward for those who have the foresight, diligence and ability to see the challenge and meet it successfully. Every country has to mind its water business. But for a country like India, where it rains for roughly 100 hours of the year, the management of water becomes even more critical. It literally determines if the country remains poor or becomes rich; diseased or healthy. In other words, water is the determinant of its future. The issue of water is not about scarcity but about its careful use and about its equitable and distributed access. Water is the starting point for the removal of poverty in the country. It becomes the basis of food and livelihood security. But what is clear is that water management strategies will need to be carefully designed so that they lead to distributed wealth generation. This will require reworking the paradigm of water management, so that it is designed to harvest, augment and use local water resources so that it leads to local and distributed wealth generation. It is also clear that local and distributed water infrastructure, will require new forms of institutional management as water bureaucracies will find it difficult to management
such vast and disparate systems. Under this context a technology that can be befitting for water management will be 3R technology (Sunita Narain 2006).

The growth of industries in the Indian context is highly phenomenal in different segments; one among them is the field of water management. According to Central Pollution Control Board, 90 percentage of the water supplied in India to the town and cities are polluted, out of which only 1.6 percentage get treated. Therefore, water quality management is fundamental for the human welfare (Gupta 1991). Globally water management has become a vital problem due to the depletion in the water sources, increase in population, pollution and global warming. It necessitates new strategies and technologies to face and solve the problem. Lots of techniques have come up in this field, needless to say that many were not able to sustain in the field due to various reasons. The present study is to analyze the scope, prospects and problems of 3R technology. This study is intended to provide insights into the prospects of establishing such a Technology.
1.7 3R TECHNOLOGY IN WATER RESOURCE MANAGEMENT

3R stands for REDUCE, REUSE and RECYCLE units and systems.

In the competitive world, profits of industries come mainly from efficient use of water with available resource. That is optimum utilization of water with minimum waste or Zero Discharge through Reduces, Reuse and Recycles systems. This has been termed under Cleaner Technology of UN Resolution for sustainable business development. 3R Technology acknowledges the facts of Cleaner Technology and intends to offer suitable solutions for Reduce, Reuse and Recycle options (3R Technology 2014).

Definition of the 3Rs

The principle of reducing, reusing and recycling resources and products is often called the "3Rs". Reducing means choosing to use things with care to reduce the amount of water generated.

Reduce can be achieved by the following measures.

- Reducing the amount of water used per product by changing the design of the product or changing the production process
- Reducing the quantity of production by extending the life of products or improving repair and maintenance technologies
• Reducing the amount of disposed water by reducing the volume of water or by selecting recyclable water

• Reusing involves the repeated use of water or parts of water which still have potential for use.

Reuse can be achieved by the following measures.

• Repeatedly using water after washing or other proper measures

• Reusing water for various application like gardening or other proper measures

Recycling means the use of water itself as a resource.

Water minimization can be achieved in an efficient way by focusing primarily on the first of the 3Rs, "reduce," followed by "reuse" and then "recycle" (Japan Ministry of Environment 2005).

Categories of 3Rs technologies and techniques

Technologies related to a wide range of activities from simple water segregation to complicate reduce, reuse and recycle of water are considered to be "3R technologies." "3R technologies" can be categorized into five divisions, mainly reduce, reuse and recycle technologies, and additionally appropriate disposal technologies and common fundamental technologies.
Application of 3Rs technologies

3R technologies are essential tools to promote in various applications. The basic concept is to reduce the amount of water input, the final disposal of water consumed in the production and transportation systems of products. "Reduce" should be considered as the first priority as it has the most direct effect on the reduction of water. It can directly reduce the water consumption and the amount of water produced by reducing the amount of input in the production process. "Reuse" is regarded as the second priority. "Recycle" is also important, however, it cannot be denied that environmental burdens such as water conservation are brought about by the intermediate treatment and manufacturing processes of recycled water (Manvendra Tiwari 2012). In the case that 3R technologies are applied, this priority setting should be emphasized.

1.8 BAT (BEST AVAILABLE TECHNOLOGIES) TECHNOLOGIES AND PRODUCTS FROM 3R TECHNOLOGY IN WATER RESOURCE MANAGEMENT

The following are benefits of the Reduce, Reuse and Recycle systems, which are the governing parameters of the Best Available Technologies, offered by 3R Technology.
Counter current rinsing – reduces water consumption during rinsing up to 90 percentages.

Effluent Evaporators for concentrating process solutions, rinse waters, membrane rejects, heat sensitive liquids, recovery of solvents, waste heat recovery, industrial wastewaters etc.

3R Technology offers Modular units of MF, UF, NF and RO for reducing the volume of the wastewater and other process liquids for recovery of water in the concentrate.

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* MF – Multi Media Filter  * UF – Ultra Filtration  
* NF – Nano Filter  * RO – Reverse Osmosis Plant

Membrane Bio Reactors [membrane filtration combined with biological process] for treatment and recycle of industrial effluents and sewage waste waters.

Advanced oxidation using UV, Ozone, Hydrogen Peroxide, and photo catalyst for complete reaction with high molecular organic contaminants.
Zero Discharge Systems and Package ETP and STP units integrated with above technologies.

Effluent Treatment Plant with emphasis on Cotton Dye Waste Water

Sewage Treatment Plant

Membrane Based Desalination Plant for Treatment of Brackish Water and Sea Water

Demineralization Plant

Zero Liquid Discharge

Waste minimization can be achieved in an efficient way by focusing primarily on the first of the 3Rs, "reduce," followed by "reuse" and then "recycle".

Sediment Filters

Activated Carbon or Charcoal Filters

Iron Filters

Reverse Osmosis

Water Softeners

Disinfection Equipment - Chlorination

Disinfection Equipment - Ultraviolet Radiation

Home Water Treatment Configuration
Sorting Through the Solutions

Now that we have established the need for something to guarantee our water quality, what are the alternatives? There are so many water systems being sold that it seems confusing. Let's identify the various processes which are available to us and see what each one's strengths and weaknesses are.

1.9 CENTRALIZED WATER TREATMENT

Building hi-tech water treatment plants to remove impurities aren't the solution: Only two percentage of water supplied to our homes is used for human consumption. A large percentage of our population has small rural or private well supplies for water. These would not be benefited by large municipal treatment centers. It isn't logical to build costly plants to treat the water we use for our lawns, to flush our toilets, and to fight fires. It's evident that it isn't practical to upgrade our treatment plants to treat all the water they process. Even if the plants were upgraded, the water has to be piped to our homes. It has the opportunity to pick up materials from the pipes before coming out of the tap.
Boiling Water

Boiling reduces the threat of living organisms. It serves as a method for killing bacteria during emergencies, it is not recommended for long term use. Very little is removed by boiling. You may kill germs, but you still have dirt, sediment, dissolved solids, bad taste, and odor remaining -- there may also be many chemical contaminants.

Point of use Water Treatment

The most efficient and cost effective approach to the problem of water purity is to treat JUST the water you will consume for drinking and cooking WHERE you will consume it. Devices for point of use water treatment are available in a wide variety of sizes, designs, and have varied claims as to their ability to remove impurities.

Mechanical Filtration

One of the most widely used water quality improvement methods is mechanical filtration which acts much like a fine strainer. Particles of suspended dirt, sand, rust and scale (i.e. turbidity) are trapped and retained, greatly improving the clarity and appeal of water. When enough of this particulate matter has accumulated on or within the filter element, it is usually discarded. This type of filter is usually
considered a pre-filter.

Ultraviolet Disinfection

Ultraviolet light, at the germicidal wavelength of 253.7 nanometers, alters the genetic (DNA) material in cells so that bacteria, viruses, molds, algae and other microorganisms can no longer reproduce. The microorganisms are considered dead, and the risk of disease from them is eliminated.

As the water flows past the UV lamps in UV disinfection systems, the microorganisms are exposed to a lethal dose of UV energy. UV dose is measured as the product of UV light intensity times the exposure time within the UV lamp array. Microbiologists have determined the effective dose of UV energy (expressed in microwatt-seconds/cm²) needed to destroy pathogens as well as indicator organisms found in wastewater.

Used properly, ultraviolet light effectively destroys bacteria, viruses and other microorganisms in water and wastewater, without using chemicals. By doing away with chemical treatment, many other problems are also eliminated. There is no longer any need to worry about operator safety or the requirement for buildings for storage and handling of dangerous solutions and gases. Costly liability insurance
premiums are significantly reduced. Testing of effluent for chlorine residual is no longer necessary, and toxicity problems associated with chlorine use are eliminated.

Ultra filtration / Reverse Osmosis

Osmosis occurs in living organisms in which there is a piece of tissue or a membrane with fluids on either side of it. Fluids having a lesser concentration will be drawn through the tissue/membrane to mix with fluids having a greater concentration. This is to equalize the concentration of substances in the fluids on both sides of the tissue/membrane. This can be illustrated if you cut open an avocado, and salt the surface of one half. In a short time, you will notice water has been drawn out of the avocado to try to equalize the concentration of salt placed on the surface of the avocado. Osmosis occurs when there are two fluids of differing concentration separated by a semi-permeable membrane. The fluid will pass through the membrane in the direction of the most concentrated solution. Osmosis is the process through which oxygen will go from our lungs into the blood stream, and water and nutrients will penetrate the root structure of a tree enabling it to grow. When we quench our thirst with water, a quantity is placed in our stomach. This water will be diffused into our system to replenish what is lost as the life processes
In the natural world surrounding us, and inside of us, there is a vast network of biological membranes. These screening barriers govern the selection and passage of chemicals and fluids. In essence, these membranes control the traffic of the life processes themselves.

Membranes help organisms carry out an immense variety of exchanges with their environment. The gills of a fish obtain oxygen from water. Our lungs extract oxygen from the air and place it in our bloodstream. In plants, the cell walls allow photosynthesis to take place by providing the medium for the transfer of carbon dioxide and oxygen. Our blood is simply recycled and renewed by many seeming miraculous processes.

One integral function is that of the kidneys. As the blood enters the kidney, it flows in small arteries in close contact with tiny excretory units of the kidney known as nephrons. From the blood, water is extracted along with wastes to become an essential component of urine. Water can remain in the nephron to become reabsorbed back into the bloodstream if not enough water is consumed to be excreted freely. Without our kidneys, we would not be able to survive. The first artificial kidney was built from a cellophane
membrane in 1944. In the early 1950's, Drs. Sidney Loeb and S. Sourirajan from UCLA Medical School developed the first synthetic membrane made from cellulose acetates. This had commercial Reverse Osmosis capabilities.

Reverse Osmosis is exactly the opposite of Osmosis. In Reverse Osmosis (RO), water having a lesser concentration of substances is derived from water having a higher concentration of substances. Tap water with dissolved solids and other materials in it is forced by the water pressure inherent in our water pipes against a membrane. The water is removed from this concentration of materials by penetrating the RO membrane, and leaving the materials behind -- this can be up to a 99% removal of dissolved solids.

The RO membrane is an ultimate mechanical filter, or ultra filter. It strains out virtually all particulate material, turbidity, bacteria, microorganisms (on potable water only), asbestos, even single molecules of the heavier organics. To appreciate the fineness of this membrane or ultra filter, its pore size would be two one hundred millionths of an inch in diameter. That's smaller than what can be seen by an optical microscope! By the remarkable phenomenon of RO, particles smaller than water molecules themselves are removed! The molecules diffuse through the membrane in a purified state, and
collect on the opposite side. Ultra filtration / RO membranes remove and reject such a wide spectrum of impurities from water using VERY MINIMAL ENERGY -- just water pressure. RO gives the best water available for the lowest price expended.

Ultra Filtration

Ultra filtration is most commonly used to separate a solution that has a mixture of some desirable components and some that are not desirable. UF is somewhat dependent on charge of the particle, and is much more concerned with the size of the particle. Typical rejected species include sugars, bio-molecules, polymers and colloidal particles. The driving force for transport across the membrane is a pressure differential. UF processes operate at 2-10 bars though in some cases up to 25 - 30 a bar has been used. UF processes perform feed clarification, concentration of rejected solutes and fractionation of solutes. UF is typically not effective at separating organic streams.

UF membranes are capable of retaining species in the range of 300-500,000 daltons of molecular weight, with pore sizes ranging from 10-1000 Angstroms (10^3-0.1 microns). These are mostly described by their nominal molecular weight cutoff (1000-100,000 MWCO), which means, the smallest molecular weight species for which the membranes have
more than 90 percentage rejection. UF usually implies separation of macromolecules such as protein from low molecular weight solvents. Pores in the support layer of the membrane are relatively larger than those of the surface layer. Material passing into fine pores can readily be transported through the open-celled, sponge-like structure of the support layer. For example, in electrode position paint recovery, the paint, composed of resin, a pigment and water are separated into two streams that can be reused. The first stream includes the water and a small amount of paint resin, which can be used to rinse the parts later in the process. The paint pigment is separated from that stream and can be reused in the paint bath, allowing the bath to be concentrated to a useable level.

It is found that, whenever the solvent of a mixture flows through the membrane, retained species are locally concentrated at the membrane surface, thereby resisting the flow. In the case of processing solution, this localized concentration of solute normally results in precipitation of a solute gel over the membrane. When processing a suspension, the solids collect as a porous layer over the membrane surface. In view of the above, it is clear that the permeate rate can be effectively controlled by the rate of transport through the polarization layer rather than by membrane properties. Hence, UF throughput
depends on physical properties of the membrane, such as permeability, thickness, process and system variables like feed consumption, feed concentration, system pressure, velocity and temperature.

UF has a wide range of Applications as shown below

- Oil emulsion waste treatment
- Treatment of whey in dairy Industries
- Concentration of biological macromolecules
- Electro coat paint recovery
- Concentration of textile sizing
- Concentration of heat sensitive proteins for food additives
- Concentration of gelatine
- Enzyme & pharmaceutical preparations
- Pulp mill waste treatment
- Production of ultra pure water for electronic Industry
- Macro Molecular separations replacing the conventional change of phase methods.

The important characteristics for membrane materials are porosity,
morphology, surface properties, mechanical strength and chemical resistance. Polymeric materials, viz., polysulfone, polypropylene, nylon 6, Poly Tetra Fluro Ethylene (PTFE), PVC, acrylic copolymer etc. have been used successfully as UF membranes. Inorganic materials such as ceramics, carbon based membranes, zirconia etc. have been commercialized by several vendors.

UF may find wide range of applications in the near future and some of those processes important from the separation and energy savings point of view are mentioned below.

REVERSE OSMOSIS

Unlike water filtration, that can only remove some suspended materials larger than 1 micron, the process of reverse osmosis (RO) will eliminate the dissolved solids, bacteria, viruses and other germs.
contained in the water. RO is essentially a pressure driven membrane diffusion process for separating dissolved solutes. The RO is generally used for desalination seawater for its conversion into potable water. The salient features of the process are that it involves no phase change and it is relatively a low energy process.

RO is probably the most common treatment technique used to reduce the dissolved solids in poor quality source water in residences connected to private water supplies. Reverse osmosis is primarily used to remove the dissolved minerals from an otherwise less than suitable water supply. Most reverse osmosis systems, when new, are capable of removing 90 percentage of the total dissolved solids but efficiency of the system declines as the reverse osmosis membrane ages.

Reverse Osmosis Effectively Reduces

The Following:

1. Particulate matter, turbidity, sediment, etc.
2. Colloidal matter.
3. Total dissolved solids (up to 99 percentage).
4. Toxic metals.
5. Radium 226/228
6. Microorganisms (potable water only)
7. Asbestos

8. Pesticides and herbicides (coupled with AC).

Reverse Osmosis And Activated Carbon Adsorption

Ultra filtration / RO alone will not remove all of the lighter, low molecular weight volatile organics such as THM's, TCE, vinyl chloride, carbon tetrachloride, etc. They are too small to be removed by the straining action of the RO membrane. Their chemical structure is such that they aren't repelled by the membrane surface. Since these are some of the most toxic of the contaminants found in tap water, it is very important that a well designed carbon filter be used in conjunction with the membrane. In some applications, Activated Carbon is used before the membrane. In ALL applications with quality RO systems, there is AC after the membrane. This means that post AC filters don't have to contend with bacteria and all of the other materials which cause fouling and impair performance if AC follows a well maintained membrane.

Not all RO systems are created equally. The engineering and experience behind the RO design is crucial to it's overall performance and dependability. The typical time required to purify one gallon of RO water is three to four hours. RO uses water to purify water. This
is what's known as the rate of recovery. Superior RO's use three gallons of brine (waste water) to make one gallon of purified water, and have an automatic shut-off. Some systems have used up to twenty gallons of brine to purify one gallon of product water. Brine is necessary to remove excess accumulated materials from the RO membrane. These materials have been rejected from the purified water, and if left in the system impair efficiency. Our bodies also have a waste water elimination system through the kidneys. If we can't purge our bodies of these waste materials, we die. Many owners of RO systems direct brine outside and use it in an additional drip line for their gardens, etc.

Almost all RO membranes are made polymers, cellulosic acetate and matic polyamide types rated at 96 percent -99+ percent NaCl rejection. RO membranes are generally of two types, asymmetric or skinned membranes and thin film composite (TFC) membranes. The support material is commonly polysulfones while the thin film is made from various types of polyamines, polyureas etc.

RO membranes have the smallest pore structure, with pore diameter ranging from approximately 5 - 15 Å (0.5 nm - 1.5 nm). The extremely small size of RO pores allows only the smallest organic molecules and unchanged solutes to pass through the semi-permeable
membrane along with the water. Greater than 95 – 99 percentage of inorganic salts and charged organics will also be rejected by the membrane due to charge repulsion established at the membrane surface.

RO Finds Extensive Applications In The Following

Potable water from sea or brackish water

Ultra pure water for food processing and electronic Industries

Pharmaceutical grade water

Water for Chemical, Pulp & Paper Industry

Waste Treatment etc

Future Directions for Ro Applications

Municipal and Industrial Waste Treatment

Process water for Boiler

De – Watering of feed streams

Processing high – temperature feed – stream etc

In the last six to eight years the technology has gained industry acceptance as a viable water treatment option for many different fluid separation applications. Low operating costs and the ability to remove
organic contaminants and 95-99 percentages of inorganic salts with minimal chemical requirements make RO an attractive technology for many industrial applications.

Deionization

The process of deionization (DI) is worth discussing even though it isn't a very practical water treatment method for household use. It has appeared in several home water treatment devices however. DI is a chemical process that utilizes minute plastic beads called resins. As untreated water flows over these treated resins, the ions of total dissolved solids are leached from the water. When the resin beads become saturated they must be removed, and regenerated with acid or caustic chemicals. DI removes ONLY charged particles (total dissolved solids). DI is not capable of removing dirt, rust, sediment, pesticides, organic toxins, asbestos, bacteria, virus at all. It is therefore used in conjunction with other water treatment methods. The resins also will provide an environment that encourages bacteria growth. Water softeners work by the principle of ion exchange as well. The resin beads in a water softener will give two ions of sodium for an ion of calcium or magnesium. With the removal of the calcium and magnesium ions, the water is no longer hard.
Micron Filtration

Micron filtration is a form of filtration that has two common forms. One form is cross flow separation. In cross flow separation, a fluid stream runs parallel to a membrane. There is a pressure differential across the membrane. This causes some of the fluid to pass through the membrane, while the remainder continues across the membrane, cleaning it. The other form of filtration is called dead-end filtration or perpendicular filtration. In dead-end filtration, all of the fluid passes through the membrane, and all of the particles that cannot fit through the pores of the membrane are stopped.

Cross flow micron filtration is used in a number of applications, as either a pre filtration step or as a process to separate a fluid from a process stream. Dead-end micron filtration is used commonly in stopping particles in either pre filtration or final filtration before a fluid is to be used. Cartridge filters are typically composed of micron filtration media.

This is by far the most widely used membrane process with total sales greater than the combined sales of all other membrane processes. Micron filtration has numerous small applications. It is essentially a sterile filtration with pores (0.1-10.0 microns) so small that microorganisms cannot pass through them.
Micron filtration is a process of separating material of colloidal size and larger than true solutions. A MF membrane is generally porous enough to pass molecules of true solutions, even if they are large. Micron filters can also be used to sterilize solutions, as they are prepared with pores smaller than 0.3 microns, the diameter of the smallest bacterium, *pseudomonas diminuta*. While the mechanism for conventional depth filtration is mainly adsorption and entrapment, MF membranes use *sieving mechanism* with distinct pore sizes for retaining larger size particles than the pore diameter. Hence, this technology offers membranes with absolute rating, which is highly desirable for critical operations such as sterile filtration of parental fluids, sterile filtration of air and preparation of particulate, free-water for the electronics industry.

The MF membranes are made from natural or synthetic polymers such as cellulose nitrate or acetate, poly Vinylidene Di Fluoride (PVDF), polyamides, polysulfone, polycarbonate, polypropylene, PTFE etc. The inorganic materials such as metal oxides (alumina), glass, zirconia coated carbon etc. are also used for manufacturing the MF membranes.

The properties of membrane materials are directly reflected in their end applications. Some criteria for their selection are mechanical strength, temperature resistance, chemical compatibility, hydrophobility, permeability perm selectivity and the cost of membrane material as well
as manufacturing process.

Micron Filtration Has A Wide Array Of Applications as mentioned Below

Preparation of parenterals and sterile water for pharmaceutical Industry. Food & Beverages (Concentration of fruit juices and alcoholic beverages) Chemical Industry Microelectronic Industry

Fermentation Laboratory / analytical uses etc.

The following are the likely applications of MF in the near future. In biotechnology for concentration of biomass, separations of soluble products In diatomaceous earth displacement In non – sewage waste treatment for removing intractable particles in oily fluids, aqueous wastes which contain particulate toxics and stack gas In paints for separating solvents from pigments etc.

1.10 NANOFILTRATION

Nanofiltration is a form of filtration that uses membranes to preferentially separate different fluids or ions. Nanofiltration is not as fine a filtration process as reverse osmosis, but it also does not require the same energy to perform the separation. Nanofiltration also uses a membrane that is partially permeable to perform the separation, but the
membrane's pores are typically much larger than the membrane pores that are used in reverse osmosis.

Nanofiltration is most commonly used to separate a solution that has a mixture of some desirable components and some that are not desirable. An example of this is the concentration of corn syrup. The Nanofiltration membrane will allow the water to pass through the membrane while holding the sugar back, concentrating the solution. As the concentration of the fluid being rejected increases, the driving force required to continue concentrating the fluid increases. Nanofiltration is capable of concentrating sugars, divalent salts, bacteria, proteins, particles, dyes, and other constituents that have a molecular weight greater than 1000 daltons. Nanofiltration, like reverse osmosis, is affected by the charge of the particles being rejected. Thus, particles with larger charges are more likely to be rejected than others. Nanofiltration is not effective on small molecular weight organics, such as methanol.

Nanofiltration is a form of filtration that uses membranes to separate different fluids or ions. NF is typically referred to as "loose" RO due to its larger membrane pore structure as compared to the membranes used in RO, and allows more salt passage through the membrane. Because it can operate at much lower pressures, and passes some of the inorganic salts, NF is used in applications where high
organic removal and moderate inorganic removals are desired. NF is capable of concentrating sugars, divalent salts, bacteria, proteins, particles, dyes and other constituents that have a molecular weight greater than 1000 daltons.

Membranes used for NF are of cellulosic acetate and aromatic polyamide type having characteristics as salt rejections from 95 percent for divalent salts to 40 percent for monovalent salts and an approximate 300 molecular weight cut-off (MWCO) for organics. An advantage of NF over RO is that NF can typically operate at higher recoveries, thereby conserving total water usage due to a lower concentrate stream flow rate. NF is not effective on small molecular weight organics, such as methanol.

1.11 BACKGROUND

The water is being used extensively at the Domestic, Office and Industry level. The knowledge and concern about water resource management of the people who are concerned with these areas are of prime of importance. Measuring their knowledge about water resource management specifically with reference to 3R technology necessitates this study.
1.12 NEED FOR THE STUDY

The growth of industries in the Indian context is highly phenomenal in different segments; one among them is the field of water management. According to Central Pollution Control Board, 90 percentage of the water supplied in India to the town and cities are polluted, out of which only 1.6 percentages gets treated. Therefore, water quality management is fundamental for the human welfare (Gupta1991). Globally water management has become a vital problem due to the depletion in the water sources, increase in population, pollution and global warming.

The demand for water and water treatment is a never ending phenomenon in human life owing to the growth in population, technological and industrial development, depletion in natural water resources etc. In this context knowledge about water, understanding the importance of water treatment and developing an attitude towards water treatment are of utmost importance. In this direction the industrial growth and development towards water treatment is the present scenario of industrial sector. We observe 'world water day March 22\textsuperscript{nd} in order to remind the people the importance of water in human life. But still people are not aware of and they lack sufficient knowledge about water. The general public are to be educated in the
directions of significance of water, knowledge about water treatment and various technologies behind water treatment particularly technology behind water treatment and its worthiness. This research tool will be of immense use for the people who are concerned with water management, water treatment and administrative bodies to manage the water resources effectively. In turn it will help in measuring and developing water resource management methods.

This necessitated the researcher to develop a research tool to measure the water resource management at domestic, office and industrial level.

1.13 STATEMENT OF THE PROBLEM

Although most countries give first priority to satisfaction of basic human needs for water, one fifth of the world's population is without access to safe drinking water and half of the population is without access to adequate sanitation. These service deficiencies primarily affect the poorest segments of the population in developing countries. In these countries, water supply and sanitation for urban and rural areas represents one of the most serious challenges in the years ahead. Water is increasingly seen as a key constraint on food production, on a par with, if not more crucial than, land scarcity. All human activities need
water and produce waste, but some of them need more water or produce more waste per job than others. This consideration has to be taken into account in economic development strategies, especially in regions with scarce water resources. Water has a value as an economic good. Many past failures in water resources management are attributable to the fact that water has been – and is still – viewed as a free good, or at least that the full value of water has not been recognized. In order to extract the maximum benefits from the available water resources there is a need to change perceptions about water values and to recognize the opportunity costs involved in current allocate patterns. The water management where there is lot of technological change. Those changes have to be effected for which measuring the knowledge of water resource management is essential to effect any change particularly to make people to practice new water management strategies at domestic, office and industrial sector.

The problem chosen for the study may be stated as follows:

“Challenges in the implementation of 3R (Reduce, Reuse and Recycle) technologies in water resource management”
1.14 OBJECTIVES

1. To develop three research tools to measure the knowledge of Water Resource Management at domestic sector, Office sector and Industrial sector with reference to 3R technology.

2. To find out the level of water resource management in the Domestic sector, Office sector and Industrial sector.

3. To find out the availability and usage of facility of water resource management at the Domestic sector and office sector.

4. To find out the consistent use of Reduce, Reuse and Recycle in the water resource management at the Domestic sector, Office sector and Industrial sector.

5. To find out the significant difference if any between the water resource management at Domestic sector, Office sector and Industrial sector and the background variables namely:
   - Gender
   - Educational qualification
   - Occupation
   - Number of family members
   - Nature of Residence
   - Monthly Income
6. To find out the level of Water Resource Management at the Domestic sector, Office sector and Industrial sector with reference to 3R technology.

7. To find out the background factors that contribute for better water resources management

1.15 HYPOTHESES

1. The level of water resource management in the Domestic, Office sector and Industrial sector is low

2. The availability and utility of water resource management facility at the Domestic sector and Office sector is low

3. The practice of Reduce, Reuse and Recycle in the water resource management at the Domestic sector, Office sector and Industrial sector is low.

4. There is no significant difference in the water resource management at domestic sector, Office sector and Industrial sector and the background variables namely:
   - Gender
   - Educational qualification
   - Occupation
   - Number of family members
• Nature of Residence

• Monthly Income

5. The Water Resource Management at the Domestic sector, Office sector and Domestic sector with reference to 3R technology is low.

6. No background factors have contribute for better water resources management

1.16 METHODOLOGY

Survey method has been used for collecting the data.

1.17 SAMPLE

The term sample refers to a small group of individuals taken from a large population. A sample may be defined as a finite number of observations or cases, selection from all areas in a particular universe, often assumed to be representative of which it is a part Good (1973). A sample is a small proportion of a population selected for observation and analysis by observing the characteristics of the sample; one can make certain inferences about the characteristics of the population from which it is drawn John W. Best (2001).

The sample for the present study was chosen from Chennai city only. The sample of the study consists of families, offices and Industries of the Chennai city. Purposive sampling method was used to select the
sample. Proportionate weightage was given to domestic, office and industry sample. The total sample includes 430 from domestic sector, 240 from office sector and 100 from industrial sector.

1.18 TOOLS

In order to collect data relating to the water resource management, the researcher developed three different research tools related to Domestic sector, office sector and Industrial sector entitled:

- Water resource management at domestic sector
- Water resource management at office sector
- Water resource management at industrial sector
- Availability and usage of facilities for water management - at domestic sector
- Availability and usage of facilities for water management - at office sector
- The items in the tool focus on water resource management with reference to 3R Technology namely Reduce, Reuse and Recycle which are the challenging parameters in the water resource management.
1.19 STATISTICAL TECHNIQUES

In order to analyse the data the following statistical techniques have been used.

1. Descriptive analysis
2. Analysis of Variance
3. Regression analysis

1.20 LIMITATIONS OF THE STUDY

- The present study is limited to the samples chosen from Chennai city only.

- The study is restricted to the factors of water resources management namely Reduce, Reuse and Recycle.

- The sample size varies with reference to domestic, office and industrial sector keeping in mind the total population of the respective sector where equal chances were not given to all the three sectors owing to the practical constraints of the researcher.

1.21 RESUME OF THE SUCCSEADING CHAPTERS

- Chapter II deals with review of related literature.

- Chapter III comprises of methodology used, sample selection tools developed and administration of the research tool.
- Chapters IV consist of analysis and interpretation of data.
- Chapter V includes summary of the work done findings suggestions conclusions and suggestions for further research.
- Bibliography and the Appendices follows chapter V.