WATER BALANCE CONCEPT

IN

SKF INDIA LIMITED, BENGULURU

Final year project report

Submitted by

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INTERNAL GUIDE

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ABSTRACT

Water Balance can be used to describe the flow of water in and out of the system. The first step of this project is to analyze the water distribution inside the plant and then making the flow chart of water routes. From this we got to know how much of water we are consuming daily. The main objective of the Project is to reduce the water consumption by analyzing which is the areas consumption; we have to give control measures and make the system more efficient and safe to the people and also to save the water for future generation. The idea of the concept is to stimulate individuals and corporations that undertake water consuming or polluting activities to make their activity 'water balance' by reducing water consumption and pollution & by compensating the negative impacts of remaining water consumption and pollution through investing in projects that promote the sustainable and equitable use of water within the environment and community that is affected. In this Paper the concept of water neutrality is discussed in detail and the concept is applied to a bearing manufacturing industry.

Keywords: *Water balance, water consumption, manufacturing industry,etc*

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RO	REVERSE OSMOSIS
ppm	PARTS PER MILLION
KL	KILOLITRES
SW	SOFTENER WATER
DW	DOMESTIC WATER
GTC	GLOBAL TECHNICAL CENTRE

CHAPTER 1

INTRODUCTION

1.1 GENERAL

Water is important source of our living life, but nowadays fresh water is difficult to get. What are the reasons behind in that? Anyone would think about that when it is using abundantly? Why they didn't get water in some regions in India? Because nowadays due to development of industrial growth and human factor the percentage of water is very less in ground level. If this condition continues, there will be no water for drinking purpose by 2040 as per Indian council of agricultural research in New Delhi. So now itself everyone have to take necessary steps for improving the water sustainability for future generation.

Recent Reports on Water**:**

Recent report of water as per the Ministry of Water Resources, India has 18% of the world's population but has only 4% of total usable water resources. Official data shows that in the past decade, annual per capita availability of water has already decreased. Here are some more facts to enunciate the upcoming water crisis:

- India's annual per capita availability of water decreased from 6,042 cubic meters in the year 1947 to 1,545 cubic meter in 2011.
- In 2001, India's annual per capita availability of water was 1,816 cubic meter.
- By 2025, India's annual per capital availability of water will further reduce to 1,340 cubic meters and by 2050 to 1,140 cubic meters.
- 90 % of waste water discharged in rivers fails to meet environmental norms.
- 65% rainwater runoff goes into the sea, which is a major wastage.
- In India, agriculture sector is the biggest user of water followed by domestic sector and industrial sector. These severe shortages of water are also leaving many farmers unable to grow crops and provide food for their livestock. As a result of this lack of income, and increasingly a depletion of their backup resources that has driven people deeper into debt, India has seen an increase in farmers committing suicide in the last four years. While some have

unwillingly moved out for the sake of their boys' and their own future, others have organized themselves against the authorities to demand protection for their livelihood

1.2 NEED FOR THE STUDY

- To increase the sustainability of water
- To conserve the water
- To reduce the regeneration of waste

1.3 OBJECTIVES OF THE STUDY

- Development of water distribution network.
- Development of water balance flow sheet.
- Effective utilization of natural resources and the enhancement of water conservation through the development.
- Demonstration of a methodology for monitoring, control and reduction of water losses.

1.4 INTRODUCTION OF SKF COMPANY

SVENSKA KULLAGERFABRIKEN (SKF)

SKF has been a leading global technology provider since 1907. Our fundamental strength is the ability to continuously develop new technologies – then use them to create products that offer competitive advantages to our customers. We achieve this by combining hands-on experience in over 40 industries with our knowledge across the SKF technology platforms: bearings and units, seals, mechatronics, services and lubrication systems. Our success is based on this knowledge, our people, and our commitment to SKF Care principles.

"Increase efficiency, decrease energy"

The focus of SKF's technology development today is to reduce the environmental impact of an asset during its lifecycle, both in our own and our customers' operations. The SKF beyond Zero product portfolios is the latest example of what SKF has to offer in this area. SKF's roots in India can be traced back to 1923, when a trading arm of SKF Group was set up in Kolkata. Since then SKF has been serving the Indian market with high quality bearings for over 3 decades. SKF India Ltd was incorporated

in the year 1961 as a result of collaboration between AB SKF, Associated Bearing Company limited and Investment Corporation of India Ltd and the first manufacturing plant was commissioned in Pune in the year 1965. Today, with 3 manufacturing facilities located in Pune, Bangalore and Haridwar, with 11 sales offices across India and a supplier network of over 300 distributors, SKF continues to serve the varied markets with reliable solutions. Over the years the company has evolved from being a pioneer ball bearing manufacturing company to a knowledge-driven integrated solutions provider, helping customers achieve sustainable and competitive advantage.

CHAPTER 2

LITERATURE REVIEW

S.NO	OBJECTIVES / STUDY ASPECTS	FINDINGS	CONCLUSIONS	REFERENCES
1.	A water balance investigation was performed for a representative electrolytic manganese metal (EMM) enterprise to study the details of water consumption and generation in the production process.	Integrated wastewater treatment approach was put forward to recover useful chemicals from the process wastewater	Complete wastewater recycling was achieved after water balance regulation and optimization.	*Fuhuan Xu:Linhua Jiang:2014*
2.	This paper explores the possibility of using a process cycle where wastewater treatment is intended for water recycling, taking into account the mass balance of materials other than water and the energy balance as well.	1) Investigation of the current water balance (2) Optimization of the water consuming processes and (3) Development of an overall concept for the optimized processes, with a zero discharge or virtual zero discharge of water (and other materials), and a minimal consumption of energy.	1. Identified the area of water route and investigated the current water balance. 2. Determined where membrane processes is required for water recycling.	*B.Van Der Bruggen: L.Braeken:2005*
3.	The water balance for the Basin of the Valley of Mexico and implications for future water consumption	Calculated the evapotranspiration and ground water exploitation rates.	Developed possible solutions for future water consumption	*P. Birkle: V. Torres Rodríguez: E. González Partida:2002*
4.	This paper examines increased pressure on Lebanon's water resources requiring the formulation and implementation of a comprehensive management plan to meet future water demands	Water resources are described with the corresponding present and future water balance, environmental stresses, and constraints facing the water sector in Lebanon.	This paper concludes with series of recommend.	*B.El-Fadel: M.Zeineti: D.Jamali:2000*

CHAPTER 3

METHODOLOGY

3.1 WATER BALANCE CONCEPT

Water balance estimation is an important tool to assess the current status and trends in water resource availability in an area over a specific period of time. Furthermore, water balance estimates strengthen water management decision-making, by assessing and improving the validity of visions, scenarios and strategies

In hydrology, a water balance equation can be used to describe the flow of water in and out of a system. A system can be one of several hydrological domains, such as a column of soil or a drainage basin.

Conservation of Mass:

Change in storage = Input - Output

Equation is divided by step of interest; we change masses or volumes to rates and we get the final equation of water balance in terms of flow rates.

This equation was the principle of conservation of water in a closed system.

Water Balance Estimations:

In the natural environment, water is almost constantly in motion and is able to change state from liquid to a solid or a vapor under appropriate conditions. Conservation of mass requires that, within a specific area over a specific period of time, water inflows are equal to water outflows, plus or minus any change of storage within the area of interest. Put more simply, the water entering an area has to leave the area or be stored within the area. The simplest form of water balance equation is as follows:

$$\mathbf{P = Q + E \pm \Delta S}$$

Where, P is precipitation, Q is runoff, E is evaporation and ΔS is the storage in the soil, aquifers or reservoirs.

In water balance analysis, it is often useful to divide water flows into ‘green’ and ‘blue’ water. ‘Blue’ water is the surface and groundwater that is available for irrigation urban and industrial use and environmental flows. ‘Green’ water is water that has been stored in the soil and that evaporates into the atmosphere. The source of ‘green’ water is rainfall or ‘blue’ water has been used for irrigation.

Water Balance Analysis can be used to:

- Assess the current status and trends in water resource availability in an area over a specific period of time.
- Strengthen water management decision-making, by assessing and improving the validity of visions, scenarios and strategies.

3.2 DATA REQUIRED FOR DOING THE WATER BALANCE:

i. Flowmeter
ii. Pressure sensors
iii. Water quality data
iv. Piping sizes
v. Manufacturer's equipment sizes

Historical Data Requirement:

i. Readings from existing flowmeters operational data (tons of material generated, widget quantities produced, gallons of chemical manufactured)
ii. Discharge pump rates or duration times
iii. Engineering drawings (Municipal lines, process infrastructure, reclaim and sewer system)

What are the parameters required for doing the water balance?

Existing water and wastewater streams should be defined in terms of flow rate, water quality, temperature, contaminant loading, or any other relevant parameters (TSS, BOD, chlorides, pH, etc.). If the relevant parameters are unknown, the water balance project team needs to evaluate what the important parameters are. Cooling towers typically require analyses of chlorides or conductivity, heat exchangers may require analysis of pH, TSS, TDS, and FOG. Individual unit processes may also require analyses of various chemical constituents, depending on the process and the suspect contaminants of concern in the water or wastewater. Changes over time in plant processes can also lead to new analysts or parameter is to be considered.

3.3 STEPS TO DO THE EFFECTIVE WATER BALANCE:

i. First to know the flow route of water in SKF Manufacturing company
ii. Draw the flow sheet of water storage and distributions
iii. Draw the water route map
iv. Note down the readings of flowmeter daily
v. Analyze where will be the more water usage and what are the reasons to consume the water more
vi. Gives the solution/ effective way for reducing the more water consumption

CHAPTER 4

WATER NETWORK

4.1 WATER SUPPLY NETWORK

A water supply system or water supply network is a system of engineered hydrologic and hydraulic components which provide water supply. A water supply system typically includes:

i. A drainage basin (see water purification - sources of drinking water).
ii. A raw water collection point (above or below ground) where the water accumulates, such as a lake, a river, or ground water from an underground aquifer. Raw water may be transferred using uncovered ground-level aqueducts, covered tunnels or underground water pipes to water purification facilities.
iii. Water purification facilities. Treated water is transferred using water pipes (usually underground).
iv. Water storage facilities such as reservoirs, water tanks, or water towers. Smaller water systems may store the water in pressure vessels. Tall buildings may also need to store water locally in pressure vessels in order for the water to reach the upper floors.
v. Additional water pressurizing components such as pumping stations may need to be situated at the outlet of underground or above ground reservoirs or cisterns (if gravity flow is impractical).
vi. A pipe network for distribution of water to the consumers (which may be private houses or industrial, commercial or institution establishments) and other usage points (such as fire hydrants).
vii. Connections to the sewers (underground pipes, or aboveground ditches in some developing countries) are generally found downstream of the water consumers, but the sewer system is considered to be a separate system, rather than part of the water supply system.

4.2 DESCRIPTION OF COMMON INPUTS, LOSSES AND WASTE WATER DISCHARGE

COMMON INPUTS	COMMON LOSSES	WASTE WATER DISCHARGE
Water used in production unit: Water used as an input to a water treatment process to make higher quality water. For example, purchased water is used in water treatment process to produce high quality water via distillation or reverse osmosis.	While classified as a loss, the output water from the water treatment process is a loss.	There are several wastewater treatment processes. For filtration and carbon adsorption, there are backwash streams which are discharged to wastewater. For softeners, there are also backwash, regeneration streams, and fast and slow rinses. For reverse osmosis systems, there is a reject stream that commonly goes to wastewater. For continuous water demineralizers there are continuous blowdown streams.
Water used in utilities: As an input to a water treatment process to produce softened water and or higher quality water for boiler feed water and or cooling tower makeup.	Generally a loss	Discharge the water
As makeup to the cooling towers.	Water which evaporates from the cooling tower and drift losses from ID fans	Cooling tower blow down, side stream filter blow down
As boiler feed water	steam/water which is evaporated, water/condensate which is lost from steam traps	Boiler blowdown
As once through cooling for compressors, chillers and other equipment	Generally no losses	Runoff can enter wastewater collection
Water used for Domestic purposes: Toilets Washbasins Dishwasher Area cleaning	Water consuming taps were not fitted because of that its losses more water Leakage is also one of the	To sewage treatment plant

	reason for loss	
<u>Water used for Irrigation purposes</u>: To irrigate the lawns, shrubs, plants, fields (the green areas)	Discharge to ground	Runoff water

4.3 WATER DISTRIBUTION:

For manufacturing and domestic purposes, Water is buying outside on daily basis based on demands in SKF. The outside water they are calling as M S water supply. Approximately the water coming from outside is 1, 80000 L and the water coming from bore well is 10KL daily.

For drinking purposes, they are buying the 25L can from outside .The approximate consumption of drinking water is 95 number of can per day.

SOFTENER:

Water softening is the removal of calcium, magnesium, and certain other metal cations in hard water.

Running time depends on ppm of water.

If ppm of water is more, the rejection of water is more.

In rainy days, they will use rain water for softening purpose, in that case, the water will have less ppm(like 600-700ppm) i.e. therefore the rejection is very less.

In process we need the water in the range of 60ppm, 70ppm and150pppm.

In rainy and winter season, the softener will run one cycle i.e. 6 hours where as in summer season, the softener will run two cycles i.e. 12 hours.

In SKF, Softener will run in night time only

Softener rejection water goes directly to gardening tank. (The approximate rejection of water is 30KL.

Softener water input is approximately 95KL/day and production of water from softener is approximately 45-65KL/day.

Softener water is mainly useful for the cooling tower.

COOLING TOWER:

Cooled water is needed for, for example, air conditioners, manufacturing processes or power generation. A cooling tower is equipment used to reduce the temperature of a water stream by extracting heat from water and emitting it to the atmosphere. Cooling towers make use of evaporation whereby some of the water is evaporated into a moving air stream and subsequently discharged into the atmosphere. As a result, the remainder of the water is cooled down significantly. Cooling towers are able to lower the water temperatures more than devices that use only air to reject heat, like the radiator in a car, and are therefore more cost-effective and energy efficient. In summer days, the loss is taking place by the evaporation of water.

Five cooling towers are using in SKF in that two cooling tower is responsible for chiller and remaining three is responsible for process especially in machine cooling.

REVERSE OSMOSIS:

Reverse osmosis (RO) is a water purification technology that uses a semipermeable membrane to remove larger particles from drinking water. In reverse osmosis, an applied pressure is used to overcome osmotic pressure, a colligative property that is driven by chemical potential, a thermodynamic parameter. Reverse osmosis can remove many types of molecules and ions from solutions, including bacteria, and is used in both industrial processes and the production of potable water. The result is that the solute is retained on the pressurized side of the membrane and the pure solvent is allowed to pass to the other side.

Water input= 27KL / day (approx.)

Production of RO water /day= 8800L

Water Rejection=18KL/day (approx.)

% Recovery of RO =Volume of treated water/volume of feed water used

% Recovery of RO= 33.4%

Reverse osmosis water is useful for preparing the emulsion that is used as coolant agent in manufacturing process. (Approx. 3KL is used for this purposes) and also for modular water (1KL approx.) and also used for furnace in heat treatment (approx. 1KL)

RO REJECTION WATER: Suited for laundry, car and van washing, flushing the toilets, swimming pools, decorative fountains, makeup water for cooling tower.

CHAPTER 5

RESULTS AND DISUSSION

The various steps followed to consume the less water:

i. The areas of water routes in SKF Manufacturing Industry are identified and accordingly distribution network of respective areas is found which is the first step for doing the effective water balance. (ANNEXURE 1: Figure 5.1. Water management storage and distribution at SKF Bengaluru)
    - Collected the information of water routes from low level people and made three flow sheet that is useful for doing the first step of water balance.

ii. Analyzed high consumption areas. (ANNEXURE 2: Figure5.2.Detailed water distribution network).
    - Identified the high consumption area .Example: Cooling tower, Softener.

iii. Recommended the control measures to reduce the water consumption. (ANNEXURE 3: Table 5.1.Control measures to reduce water consumption).

iv. Awareness to the workers

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TABLE 5.1 CONTROL MEASURES TO REDUCE THE WATER CONSUMPTION

LOCATION	CONTROL MEASURES
Toilet	➢ Fitting of shower nozzles in taps that will helpful to consume less water. ➢ Use low flow flushing or water efficient flushing system to conserve water. ➢ RO rejection water should be used for toilet flushing .
Canteen	➢ The way of washing the plates is not good because when they are washing, the tap is opened fully and moreover it leads to spread of water all over the room. This leads to be the stagnant in that room always and giving bad smell and it looks unclean. If we change the way of washing as we followed in olden days. Workers should sit and wash that will helpful for their health to avoid the back pain and also stagnant water will be controlled. By this way we have to consider the health to the people and also protect the environment by consuming minimal water usage. **" Maintain Cleanliness keep away from diseases"**
Cooling Tower	➢ The process of **metering, measuring, and managing laboratory facilities is essential for effective water management**. Metering and measuring help in analyzing a facility's water usage and proper management of mechanical equipment results in greater water efficiency. Making sure that the equipment is run correctly and maintained properly is the key to preventing excess water usage through leaks and malfunctioning mechanical equipment. ➢ low hardness water preferred for cooling tower makeup use ➢ The ratio of evaporation to blowdown is called the cycles of concentration. If possible, **cooling towers should be operated at six or more cycles of concentration for maximum water-efficiency**. In addition, metering the quantity of water put into and discharged from the cooling

	tower provides information that helps to better manage the efficiency of the tower. ➢ **Eliminate Single-Pass Cooling**. (Single-pass cooling uses a continuous flow of water that is circulated once through the system for cooling purposes and is then disposed of down the drain.) ➢ High efficiency Drift eliminators installed at the open top or sides.
Wash basin	➢ Waste water from washbasin line should be a separate line because if this water combines with sewage water it will give minimum recycled water after treating with sewage. ➢ In my view, the water in washbasin line will be less dirty so we can treat it separately and make use for toilets flushing. By this way we can consume the minimum water for domestic purposes. ➢ Approximately 4 to 6 liters/flush of water consumed in dual flush toilets. In flushing, the water consumption is more. It's difficult to control or reduce the usage of flushing. So we can use the treated water coming from washbasin instead of fresh water.

Awareness to the workers:

- Survey your plant daily to determine where water is wasted or could be reused.
- Setup a water conservation programs.
- Analysis the ways to increase the efficiency.

Examples:

1. Install high pressure and low volume nozzles on spray washers
2. Determine whether discharges from any one operation can be substituted for

For fresh water supplied to another operations

- Everyone should know the value of water. Weekly basis workers should discuss about the water and its treatment process.
- Every individual should know how much water is consumed daily and how much is wasted and the value of amount spent on it.
- Creating the awareness to the workers by showing the videos and presentations regarding water treatment will improve their skills.

CHAPTER 6

CONCLUSION

- Development of water balance is helpful for assessing the current status and trends in water availability
- Various steps followed to do the effective water balance in SKF Manufacturing industry.
- Suggestions are made to achieve the water sustainability by control the water consumption

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CHAPTER 7

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