
WATERSHED MANAGEMENT

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Lecture No - 40 Water Reclamation & Reuse
L40 – Water Reclamation & Reuse

- **Topics Covered**
  - Reclaimed water, Reclamation processes, Reuse of water

- **Keywords:** Water reclamation, water reuse

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Introduction – Reclaimed Water

- **Reclaimed water or recycled water** - former wastewater - treated to remove solids & certain impurities, & used in sustainable landscaping irrigation or to recharge groundwater aquifers.

- **Purpose** - sustainability & water conservation, rather than discharging treated water to surface waters such as rivers & oceans.

- **Reclaimed water** - “End product of wastewater reclamation - meets water quality requirements for biodegradable materials, suspended matter & pathogens - uses such as agriculture & sundry industry uses.
Introduction – Reclaimed Water

- For maximum water reuse/reclamation/recovery strategies such as water pinch analysis (WPA - systematic technique for reducing water consumption & wastewater generation through integration of water-using activities or processes) - it help a user to target the minimum freshwater consumption & wastewater target. It also helps in designing the network that achieves the target.

- Cost of reclaimed water exceeds that of potable water in many regions of the world.

- Using reclaimed water for non-potable uses saves potable water for drinking.

- Usage of water reclamation decreases the pollution sent to sensitive environments.

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Reclaimed Water - Concerns

- Reclaimed water - highly engineered for safety & reliability so that the quality of reclaimed water is more predictable than many existing surface & groundwater sources.
- Reclaimed water - safe when appropriately used.
- Reclaimed water planned for use in recharging aquifers or augmenting surface water receives adequate & reliable treatment before mixing with natural water & undergoing natural restoration processes.
- Some of this water eventually becomes part of drinking water supplies.
- Reclaimed water is often distributed with a dual piping network that keeps reclaimed water pipes completely separate from potable water pipes.

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Reclamation Processes

- **Preliminary treatment** – Bar screen- solids removal
- **Primary Treatment - Settling Tanks** - Readily settable and floatable solids are removed from the wastewater
- **Biological Treatment** - uses microorganisms- bacteria which digest the sludge and reduce the nutrient content
- **Secondary Treatment - Settling Tanks** - microorganisms to settle to the bottom- other small particles suspended in the water are picked up, leaving behind clear wastewater.
- **Tertiary Treatment** - Deep-bed, single-media, gravity sand filters receive water from the secondary basins and filter out the remaining solids.
- **Disinfection - Chlorine Contact Tanks**
Concept of Reuse of Water

- **Reuse** is most applicable – where large volumes of water are reused & wastes are not too contaminated
- Location of treatment plant and possible transport of renovated water – **Important considerations**
- **Treatment Processes** – Efficient and economical when flow is steady
- Generally in urban areas – Irregular flow
- **Wastewater Reclamation**: Treatment or processing waste water to make it reusable
- **Water Reuse**: Use of treated wastewater for beneficial use
Concept of Reuse of Water

- **Direct wastewater reuse**: requires pipes or other conveyance facilities for delivering reclaimed water
- **Indirect use**: Discharge of an effluent to receiving water for assimilation and withdrawals downstream
- **Pulp & Paper Industry**: Water reuse - Predominantly practiced
- **Domestic reuse**: Best recycle opportunity but amount of water recycled falls short of the total amount of water reused
- **Warm dry areas**: Suitable for domestic reuse where there is a large difference between supplied water and waste water due to losses
Concept of Reuse of Water

- **Less risk – preferred option**
  - Rainwater
  - Stormwater
  - Greywater
  - Sewage

- **High risk – Least preferred option**
  - High energy requirement


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Reuse of Water

Fig: Quality changes during municipal use of water & concept of wastewater reclamation & reuse (Mc Gauhey, 2006)
Water Reclamation & Reuse

- Water treatment for drinking water – meets standards for drinking water
- Municipal & industrial uses degrade the water quality
- **Wastewater treatment:** Treatment is carried out to the point required by regulatory agencies for protection of other beneficial uses
- Dashed line in figure represents increased quality for reuse
- Concept of reclamation and reuse will come after wastewater reaches the natural unpolluted water

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Water Reclamation & Reuse

- **Repurified Water:**
  - Generated by further advanced wastewater reclamation technologies
  - Carbon adsorption, Advanced oxidation & reverse osmosis
  - Generate much higher quality than conventional drinking water
  - Character of wastewater entering in renovated plant – Important and especially industrial waste water
  - EX: Ordinary salt brines, undesirable for if the renovated to be demineralized
Water Reuse Schemes

- Reuse from various sources – Rainwater, Drainage systems, sewer systems etc.
- Scheme depends on intended reuse
- Reuse of waste water
- Source of wastewater
- Survey of the sewer system- for finding wastewater availability for reuse
- Highly contaminated with metals or containing a high total concentration of dissolved solids- unacceptable
- Deliberate use of treated waste water in planned way is important
Water Reuse Schemes

- Waste water – Domestic/Industrial sources
- Industrial/Other Waste water – unsuitable for reuse

Scheme for Reuse from various sources.

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Water Reuse – Schemes

- **Unplanned** - cities draw water supplies from rivers that receive wastewater u/s. Water from these rivers -reused, treated, & piped into the water supply a number of times before the last d/s user withdraws the water.
- **Planned** - developed with the goal of beneficially reusing a recycled water supply.

The water reuse may be for

- **Agricultural purposes** - for agricultural reuse- preliminary, primary and secondary treatment steps - fit for discharge to the environment.
- **Industrial or domestic purposes** - may be tertiary treatment required to remove the more residual pollutants, especially the dissolved and refractory substances & micro-organisms depending on the use contemplated.

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Types of Wastewater Reuse

- Reuse of urban wastewater in agriculture and horticulture from sewered areas.
- Reuse of urban wastewater from polluted nallahs draining unsewered areas.
- Reuse in industrial and commercial establishments to meet the water shortage.
- Reuse in industry to meet various other objectives besides relief from water shortage such as ‘zero discharge’.
- Reuse for major urban & community development purposes; eg. to augment public water supplies.
Typical strategy followed by most of the industries is as follows:

- Firstly, practice as much conservation of water as possible.
- Secondly, recycle the fraction of waste water which is in relatively good condition & can be recycled back with little or no treatment.
- Thirdly, arrange more ‘reuse’ after some treatment to make the industry’s own wastewater fit for reuse.
- Lastly, if more reuse is needed, get the external sources of wastewater, such as municipal sewage.
Water Reuse in India – Example 1

**Madras Refineries & Madras Fertilizers Ltd., Chennai:**

- Madras Refineries is producing 12 Mld of reusable water and Madras Fertilizer is producing 16 Mld of reusable water since 1991.

- Here the Chennai Metro Water Board supplies secondary treated sewage (with about 120 mg/L BOD) and the Industries provide the further required treatment depending on their end-use.

Water Reuse in India – Example 2

**Vadodara Pilot Plant, Gujarat:**

- This plant uses highly polluted wastewater from a “effluent disposal channel” into which several industries (such as refineries, fertilizers, petrochemicals) discharge their raw wastes with a capacity of 3 Mld freshwater.

- The plant shows that at least 75% of wastewater could be made reusable at an operating cost of Rs. 36/1000 litres. The flow sheet adopted in the plant include:

  Wastewater -> Chem-feeds (Lime, Polyelec, Soda Ash) -> Clarification -> HCl -> Pressure Filtration -> Sodium Biosulfite -> Cartridge Filters -> Reverse Osmosis -> Degasser to Remove CO2 -> for Reuse in Industry

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Future of Water Reuse

- Due to water scarcity - Water reuse increasing
- Reuse – through recycling/ reclamation found to be effective and successful.
- Primarily - Nonpotable reuse - widely accepted practice that will continue to grow.
- More advances technologies in recycling/ reclamation
- Indirect potable reuse.
- More energy efficient
- Sustainable water management/ watershed management
- Public participation & awareness important.

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## References

- [http://wrmin.nic.in](http://wrmin.nic.in)
- [www.epa.gov](http://www.epa.gov)
Tutorials - Question!..?

- Critically analyze and study the scope of water reuse in India.
- Do the urban water scarcity can be reduced by reuse of water?
- Study and compare various case studies available on reuse and evaluate the benefits/costs.


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Self Evaluation - Questions!

- Describe the importance of reuse of recycled/reclaimed water.
- What are the important reclamation processes?
- Illustrate the “water reuse schemes”.
- Discuss various issues related to “Water reuse” in Industries.
Assignment- Questions?

- What are the main concerns about the reclaimed water?
- Illustrate the concept of “reuse” of water.
- Describe the types of “waste water reuse”.
- Which are the places where reuse is possible?
### Summary– Course on “Watershed Management”

- Introduce “Watershed Management” & establish its relevance & concepts.
- **Present** the fundamental principles, Theories, Modeling, Analyses & applications
- Demonstrate how these are used in the field of “Watershed Management”.
- Discussed various aspects of watershed & its management – **Integrated Watershed Management Approach**.
- Consists of **40 lectures** presenting the concepts, theory, applications & case studies
Summary – Course on “Watershed Management”

- **Course** - discussed various aspects of watershed development and management.
- **Watershed resources** – Land, water, Forests, Agriculture, Flora & Fauna.
- **Watershed Management**: technological, social, ecological, environmental, sustainable issues.
- **Course Focus** - technical aspects of WM; perspectives on land & water management; analyze complex issues in water management and on specific knowledge on issues of WM; **Use of Modern techniques in Watershed Management.**

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Summary – Course on “Watershed Management”

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Concluding Remarks

- Importance of “Watershed Management”
- “Holistic approach” – needed
- Watershed Management - Different aspects & approaches
- Course - all aspects of “Watershed” & related issues
- Theoretical aspects covered in the best possible way
- Number of case studies from various sources given
- Tutorial, self evaluation, assignment & unsolved questions provided
- Video course will be useful for systematic study of ‘Watershed Management’

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Concluding Remarks

Course will be useful to students - “Bachelor, Masters & Ph.D.” Levels – Civil, Agriculture, Geography, Geology, Resources, Environmental Engineering, Humanities, Management etc.

Course will be also useful to “Teachers” – teaching “Watershed & Water Management” related topics.

Also useful - “NGOs, Field Engineers, Practitioners, Scientists, Policy & Decision Makers, Gov. agencies & for all working in the area of Watershed Management”.

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Acknowledgements

- Prof. S.G. Joshi, Prof. Anupam K. Singh, Prof. V.R. Desai & Dr. A. Vinodkumar – review of the Course Videos, Slides & Materials
- Mr. Harsh V. Nunna, Ms. Vardhini V., Dr. M. Meenal, Mr. Anand Kulkarni, All M.Tech. & former Ph.D. students (Dr. Venkat Reddy, Dr. Shahapure S.S., Dr. Geetha, Dr. R.K. Sahu, Dr. Reshmidevi & others) – for Slide preparations & materials used in the presentation
- CDEEP Staff, IIT Bombay – Video Recording & Editing
- Family – Wife (Dr. Manjush) & Kids (Iype & Basil) – for the moral support.

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