





Training program on Standard Operating Procedures for operations of pumps in water and sanitation value chain

Supported by

CWAS, CRDF, CEPT University at Ichalkaranji Municipal Corporation

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CWAS CENTER FOR WATER AND SANITATION | CRDF CEPT RESEARCH AND DEVELOPMENT FOUNDATION | CEPT UNIVERSITY

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Training Report

Center for Water and Sanitation
CRDF, CEPT University and Ichalkaranji Municipal Corporation, Ichalkaranji

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Abbreviations

CWAS	Center for Water and Sanitation
CRDF	CEPT Research and Development Foundation
CEPT	Centre for Environmental Planning and Technology
SOP	Standard Operating Procedure
O & M	Operation and Maintenance
ULB	Urban Local Body
KBL	Kirloskar Brothers Limited
HP	Horsepower
VT	Vertical Turbine
HT	Horizontal Turbine
WTP	Water Treatment Plant
Q&A	Question and Answer
STP	Sewage Treatment Plant
IMC	Ichalkaranji Municipal Corporation
MVA	Mazi Vasundhara Abhiyan
MoU	Memorandum of Understanding
BEP	Best Efficiency Point
OAN	Overall Arrangement Number
SCADA	Supervisory Control and Data Aquisition
WASH	Water, Sanitation and Hygiene
APFC	Automatic Power Factor Correction

1 Summary of key findings from the workshop

The workshop on "Standard Operating Procedures for operations of pumps in water and sanitation value chain" brought together municipal staff, including engineers and pump operators, from the ULBs of Sinnar, Wai, Vita, Karad, and Ichalkaranji. As part of initiative towards energy transition CWAS conducted a preliminary energy audit study for Vita, Karad, Ichalkaranji, Wai, and Sinnar, identifying opportunities to enhance energy efficiency across the water and sanitation service chain. Based on the energy audit it was found that the pump efficiency is important component that contributes to energy efficiency of the treatment infrastructure. Hence it is important for the engineers and pump operators to be aware of various ways through which pump efficiency could be increased. In this regards a one-day training workshop is conducted at on Pump SOP for engineers and operators to improve pump efficiency and optimize energy use. Organized by the CWAS, CRDF, CEPT University, in partnership with Majhi Vasundhara and Ichalkaranji Municipal Corporation and in collaboration with KBL the workshop aimed to equip ULB officials with essential knowledge to enhance pump efficiencies. After conducting the preliminary energy audit study in Vita, Karad and Ichalkaranji it was decided that it would be helpful to organise a training on SOP training for engineers and pump operators. Based on these results, the commissioner suggested & recommended a training session on SOP for pump operations. The main objective was to empower ULB officials with practical insights on improving pump efficiency and optimizing daily operations, thus contributing to a more energy-efficient water and sanitation value chain.

Emphasis on Energy Efficiency and Pump Operations:

The workshop highlighted the crucial role of energy efficiency in water and sanitation value chain, emphasizing its direct connection to effective pump operations and the overall efficiency of the value chain. Participants were made aware that pump efficiency plays a vital role in conserving energy within treatment infrastructure, making it a key factor in optimizing the sustainability and cost-effectiveness of water and sanitation systems. The discussions reinforced the importance of efficient pump operations in reducing energy consumption and enhancing the performance of the entire service delivery process.

Knowledge Gaps and Training Needs:

Participants emphasized the presence of significant knowledge gaps in the operation and maintenance (O&M) of pumps, particularly among ground-level technicians who are directly responsible for daily operations. These gaps were related to both the technical aspects of pump functionality and the routine maintenance practices required to ensure efficient operations.

The workshop was designed to bridge these gaps by offering a balanced approach that included in-depth theoretical knowledge, covering the fundamentals of pump operations, as well as hands-on practical demonstrations. These demonstrations

allowed participants to observe real-time scenarios and learn best practices for pump maintenance and troubleshooting. This holistic approach ensured that participants not only understood the mechanical workings of the pumps but also gained the skills necessary to implement effective maintenance protocols, ultimately improving overall operational efficiency to make value chain energy efficient.

Enhancing Energy Efficiency in Water and Sanitation: Insights from Preliminary Energy Audits:

During the workshop, the CWAS team conducted an in-depth session on the preliminary energy audit study they carried out for Vita, Karad, and Ichalkaranji. The purpose of the study was to analyze energy consumption throughout the water and sanitation value chain in these cities. This session aimed to raise awareness among ULB officials about the significant amount of energy consumed in their respective city's water and sanitation systems. The CWAS team provided detailed insights into the audit findings, showcasing the current energy usage patterns and identifying key areas where energy losses occur. They also presented recommendations tailored to each city's specific needs, offering practical solutions for improving energy efficiency. By highlighting strategies such as optimizing pump operations, upgrading equipment, and implementing regular maintenance protocols, the team empowered ULB officials to take actionable steps towards reducing energy consumption and enhancing the sustainability of their water and sanitation infrastructure.

Standardized Installation and Maintenance Procedures:

The workshop provided comprehensive guidelines for pump installation, commissioning, and maintenance, emphasizing the need for standard operating procedures. Critical aspects like proper storage and handling of pump parts, alignment of pumps and drivers, and correct usage of foundation bolts and baseplates were discussed in detail. These procedures are essential to avoid common mechanical issues such as vibration, noise, and premature component failure.

Field-Level Troubleshooting and Maintenance Practices:

The participants were introduced to a troubleshooting guide that covered common mechanical issues encountered during pump operations. The guide was designed to empower operators to identify and resolve problems independently, thereby reducing dependency on external support and minimizing downtime.

Hands-On Experience through Field Visit:

A field visit to the Water Treatment Plant (WTP) at Ichalkaranji Municipal Corporation was conducted to provide participants with practical exposure. This session allowed the operators to observe the functioning of VT pumps in a real-world scenario. They engaged in interactive Q&A sessions, where trainers demonstrated various maintenance tasks and explained technical specifications and nameplate readings of the pumps.

Linkages with Manufacturers and Genuine Spare Parts Procurement:

Participants expressed concerns regarding the procurement of genuine spare parts and the lack of linkages with authorized dealers. Trainers from KBL addressed these concerns by providing information on official channels for sourcing spare parts, thereby ensuring the use of genuine components for maintenance.

Commitment to Enhancing Pump Operator Skills:

The workshop concluded with a strong commitment to ongoing skill development for engineers and pump operators, recognizing the critical role they play in maintaining and improving pump performance. Key recommendations included the development of a comprehensive training manual that would serve as a detailed guide for best practices in pump operation and maintenance. Additionally, the establishment of a technical assistance helpline was proposed to provide real-time support to technicians facing operational challenges.

Another important outcome of the workshop was the emphasis on the need for more hands-on training sessions, to be conducted regularly in collaboration with industry experts. These sessions would focus on practical troubleshooting and performance optimization techniques, further strengthening the capabilities of ULB officials in managing pump operations.

Moreover, participants discussed the value of introducing a Preliminary Energy Audit DIY Toolkit for engineers. With this toolkit, engineers would be empowered to conduct energy audits at regular intervals, enabling them to closely monitor energy consumption and assess pump performance over time. By using this tool, ULBs would be able to proactively identify inefficiencies and take timely corrective actions, contributing to long-term energy savings and enhanced operational efficiency.

2 Introductory session

The workshop began with an introductory session led by the Commissioner Mr. Omprakash Diwate of Ichalkaranji Municipal Corporation, who emphasized the importance of specialized training for ground-level pump operators. He highlighted that such capacity-building initiatives are crucial in achieving energy efficiency across water and sanitation services. The Commissioner pointed out that skilled operators can optimize the performance of water infrastructure, ultimately contributing to significant cost savings and reduced energy consumption for municipal operations.

The Commissioner also emphasized the critical role that efficient sanitation services play in ensuring public health and environmental sustainability. With increasing urbanization and rising water demand, optimizing the energy usage in water and wastewater treatment operations is more important than ever. Energy efficiency in pump operations not only contributes to lowering operational costs but also reduces the carbon footprint of urban water supply and sanitation systems. Pumps, being one of the largest energy-consuming

components in the water and sanitation value chain, are at the core of these efforts. Efficient pump operations, therefore, are essential to enhance the performance and reliability of water treatment plants. By adopting energy-efficient pump systems and proper maintenance protocols, municipalities can ensure uninterrupted services, minimize resource wastage, and support sustainable urban development.

Mr. Omkar Kane from the CWAS shared insights from a Preliminary energy audit study conducted at Vita Municipal Council. He explained how the findings of the audit led to strategic interventions, including the replacement of outdated pumps and the installation of solar power plants at pump houses. These measures not only improved the overall efficiency of water supply operations but also resulted in substantial cost savings for Vita Municipal Council. CWAS team presentation underscored the potential benefits of adopting energy-efficient practices and investing in modern equipment to enhance the sustainability of urban water and sanitation services.

The Commissioner emphasized the need for specialized training for the engineers and pump operators who manage the pumps daily. He noted that a structured training program on SOPs for pump operations would help reduce recurring operational errors and enhance overall pump efficiency.

During the preliminary energy audit, the CWAS team identified that most of the pumps installed within IMC facilities were manufactured by KBL, a leading company in the pump manufacturing industry. Recognizing the value of industry expertise, the CWAS team reached out to KBL for a potential collaboration to train IMC personnel. KBL readily agreed to support this initiative, resulting in a dedicated SOP workshop specifically tailored for ULB officials, focusing on efficient and effective pump operations.

KBL, founded in 1888, is a flagship company of the Kirloskar Group and a global leader in fluid management solutions. With over a century of expertise, KBL specializes in designing and manufacturing a diverse range of highly efficient and innovative pumping systems, valves, and fluid-handling equipment. The company's products cater to critical sectors such as water supply, power generation, oil and gas, irrigation, infrastructure, and industrial processes.

KBL is renowned for its commitment to sustainability and technological excellence, offering cutting-edge solutions that ensure reliability, energy efficiency, and environmental responsibility. With a global presence across multiple continents and a strong emphasis on research and development, KBL continues to set benchmarks in engineering innovation. The company’s dedication to quality and customer satisfaction has made it a trusted partner for industries worldwide.

The workshop was successfully executed, with the collaboration between CWAS and KBL proving highly productive. The training is expected to have a significant impact on the operational standards within IMC, empowering the engineers and pump operators with best practices to prevent errors and optimize energy use in pump management.

3 Thematic Sessions

3.1 Session 1: Preliminary Energy study for Vita, Karad, Ichalkaranji, Wai & Sinnar (Presented by CWAS team)

CWAS at CEPT University, Ahmedabad, has been providing technical assistance to municipal councils in Vita, Karad, Ichalkaranji, Sinnar, and Wai to support the planning and implementation of energy transition initiatives in water and sanitation service delivery. CWAS has been actively working on citywide inclusive strategies, emphasizing the transition to renewable energy and nature-based solutions for improving energy efficiency in water and sanitation services.

To further these efforts, CWAS signed a MoU with MVA. The goal of this partnership is to assist cities in their journey toward providing climate-resilient WASH services.

As part of this energy transition initiative, CWAS conducted a preliminary energy audit study for Vita, Karad, Ichalkaranji, Wai, and Sinnar, focusing on identifying opportunities to enhance energy efficiency in the water and sanitation service chain. Based on the audit findings, it was highlighted that pump efficiency plays a crucial role in contributing to the overall energy efficiency of the treatment infrastructure.

Key Insights from the Preliminary Energy Audit Session:

CWAS team conducted a session on the Preliminary Energy Study for the five cities mentioned. The session provided an overview of:

- The importance of energy audits in municipal services, particularly in WASH.
- The energy consumption patterns across various sectors, focusing on the points where energy is consumed most significantly at the ULB level.

Programs Related to Energy Efficiency:

CWAS team began the session by discussing national programs aimed at improving energy efficiency in India, and he provided insights into the types of energy audits that can be conducted. He explained how CWAS arrived at the decision to carry out preliminary energy audits for the five cities and outlined the audit's objectives.

Objectives of the Energy Audit:

The primary objective of the audit is to conduct a walk-through energy audit to:

- Identify areas of energy wastage within the water supply and sanitation service chain.
- Suggest effective measures to optimize energy consumption and pinpoint specific areas where energy-saving initiatives can be implemented.

- Achieve cost savings and reduce the carbon footprint by enhancing environmental sustainability and financial efficiency in municipal services.

Energy Consumption in Maharashtra:

CWAS team then explained the distribution of electricity usage in Maharashtra and emphasized that municipal services account for approximately 6% of the state's total electricity consumption. Out of this, WASH services contribute to about 40-70% of the total energy consumption and account for 50-70% of municipal energy costs.

Importance of Energy Efficiency in WASH Services:

Achieving energy efficiency in municipal WASH services can significantly reduce energy consumption and costs. CWAS team stressed that conducting energy audits for water and sanitation services is essential for achieving these goals.

Pumping Asset Mapping and Analysis:

Following a discussion on the demographics of the cities involved, CWAS team then explained the process of pumping asset mapping across the water and sanitation service chain in the five cities. This involved:

- Analyzing the efficiency of pumps, calculating potential energy savings per year, and determining the payback period for various interventions.
- Identifying pumps that ULBs need to replace in the water and sanitation value chain to improve energy efficiency.

CWAS Recommendations:

Based on the findings of the energy audit, CWAS provided various recommendations to the respective cities, which were aimed at improving the energy efficiency of water and sanitation services. These recommendations focused on practical solutions that the ULBs could implement to:

- Improve pump efficiency.
- Reduce energy consumption.
- Lower operational costs while improving service delivery.

Following a preliminary energy audit conducted at Vita, Karad, and Ichalkaranji, CWAS has recommended that these ULBs replace pumps in their water and sanitation value chains that have an energy efficiency of less than 50%. The audit revealed that a total of 27 pumps across different locations in the water and sanitation value chain of these cities require replacement to enhance energy efficiency. The projected cost for replacing all identified pumps across the three cities is approximately Rs. 8 crore. This investment is expected to yield significant financial benefits, resulting in an estimated savings of Rs. 15 crore in energy costs over time. In addition to the pump replacements, CWAS has advised the installation of APFC panels in Vita and Karad to optimize energy usage further. The installation cost for these panels is around Rs. 33 lakh per city, with anticipated annual energy savings of approximately Rs. 1 crore for Vita and Rs. 5 lakh for Karad. This recommendation targets improved power management, reducing energy losses and associated costs. Vita has already implemented the recommendations provided by the CWAS team, resulting in a more energy-efficient water and sanitation value chain. Karad and Ichalkaranji are in the process of executing the recommended

measures and are expected to see similar improvements upon completion. This proactive approach aims to reduce operational costs, improve energy efficiency, and promote sustainable resource management in these ULBs.

Conclusion: The main focus of the session was to provide ULBs with a clear understanding of how they can improve energy efficiency in water and sanitation services. It also highlighted the importance of conducting energy audits in these cities to achieve both environmental and financial benefits. The session encouraged ULBs to take proactive steps in optimizing energy usage and moving towards more sustainable WASH service delivery through energy-efficient technologies and practices.

3.2 Session 2: Installation and Operation of VT Pumps (Presented by Kirloskar Brothers Limited (KBL))

The second session of the workshop, led by KBL team, delved into the critical aspects of the installation, operation, and maintenance of Vertical Turbine (VT) Pumps. KBL team began by emphasizing the importance of proper installation and handling of these pumps to ensure their long-term reliability and optimal performance.

His presentation covered a wide range of topics, starting with the basics of storage and handling procedures. He highlighted how correct storage methods can prevent premature wear and tear, while proper handling techniques are essential to avoid mechanical damage during transportation and installation.

The session then moved on to discuss the technical features of Vertical Turbine Pumps, including their design specifications, capacity, and efficiency metrics. KBL team explained how understanding these features is crucial for selecting the right pump for specific applications, ensuring that it meets the operational needs of the system.

Equipment requirements for the installation of VT pumps were also discussed, with KBL team detailing the tools and machinery necessary to carry out a successful installation. He provided insights into how using the appropriate equipment can simplify the installation process

and reduce the risk of errors that could lead to inefficiencies or pump failure.

Finally, KBL team in their presentation shared best practices for installation and commissioning, offering step-by-step guidelines to ensure that the pump operates at peak performance from the moment it is commissioned. These practices included aligning the pump correctly, ensuring that it is securely mounted, and conducting thorough checks before starting operations to prevent operational issues.

In summary, KBL team's session provided a comprehensive overview of the entire lifecycle of Vertical Turbine Pumps—from proper storage and installation to long-term operation and maintenance. He underscored that following these best practices can significantly extend the lifespan of VT pumps and enhance their performance, ultimately leading to cost savings and improved system efficiency.

Storage and Handling of VT Pumps: KBL team highlighted that proper storage and handling of VT pump components are fundamental steps that must not be overlooked. He explained that delivered parts should be carefully inspected for damage before acceptance. It is crucial to ensure that all components are stored in a clean, dry area to prevent deterioration,

particularly rusting. Proper sequencing of parts during storage was emphasized to avoid misplacement or confusion during the assembly process. Special care should be taken to handle the heavy components using cranes, chain pulley blocks, and other lifting equipment to prevent mishandling that could result in misalignment or mechanical damage.

Pump Installation and Commissioning: The session provided an in-depth discussion on the installation and commissioning process of large VT pumps. Participants were informed that careful installation is essential to prevent future operational issues and to maintain the efficiency of the pump. KBL team detailed the need for pre-commissioning checks such as verifying the free rotation of the pump, checking the direction of motor rotation, and ensuring proper oil levels in the bearing housing. Additional checks include inspecting the sealing connection, verifying the stuffing box packings, and ensuring that foundation bolts are tightened properly. Proper support for delivery pipes was also recommended to avoid structural strain on the pump casing.

After commissioning, a set of post-commissioning checks must be followed to confirm that the pump is operating correctly. KBL team explained that the radial impeller should be checked by closing the delivery valve. Once the direction of rotation is verified, the pump should be brought up to full speed before slowly opening the delivery valve. When stopping the pump, it is essential to close the delivery valve gradually before shutting down the motor to prevent water hammer and potential damage.

Equipment and Tools for Pump Erection: The importance of using the right equipment during the installation process was stressed. KBL team explained that the use of cranes, chain pulleys, lifting hooks, and jute ropes is necessary for handling the large and heavy components of VT pumps. He also recommended using leveling equipment with an accuracy of 0.02mm/m for precise alignment. Other standard tools, such as master levels and straight edges, are essential for ensuring that foundation plates are perfectly leveled and that the alignment of various units is maintained throughout the installation process.

Technical Features of VT Pumps: The technical features of VT pumps were elaborated upon, covering aspects such as self-lubrication systems, water and oil lubrication methods, and delivery options. The pumps are available in a variety of configurations, including above-ground and below-ground delivery setups, solid shaft and hollow shaft designs, and forced lubrication systems. KBL team provided cross-sectional drawings to illustrate the structure and components of these pumps, ensuring participants could visualize and understand the internal working mechanisms.

Pump House Requirements: KBL team discussed the structural and spatial requirements for pump houses, which are crucial for maintaining operational efficiency and safety. A pump house must be designed to withstand the hydraulic forces generated by VT pumps and should provide ample space for routine maintenance and emergency repairs. The pump house should include dedicated storage areas for spare parts and tools, ensuring that maintenance activities can be carried out without unnecessary delays.

Pump Installation Process: A detailed step-by-step guide for the installation of VT pumps was presented. The session covered foundation pocket inspection, leveling of sole plates, and

the assembly of each pump unit. Participants were advised to use non-shrinkable cement like GP-2 for foundation works to achieve better stability and strength. KBL team also introduced the concept of “blue matching” between the sole plate and discharge head base to ensure proper alignment. The assembly of the shaft using muff coupling was also demonstrated to provide participants with a practical understanding of the process.

Benefits and Applications of VT Pumps: The benefits of using VT pumps were discussed in depth. VT pumps are advantageous as they do not require priming and occupy less floor space compared to other types of pumps. Their ability to operate under varying water levels and handle high flow rates makes them suitable for a wide range of applications, such as irrigation, power stations, city water supply, fire-fighting systems, condensate extraction, and flood control.

VT Pump Product Range: The session concluded with an overview of the product range offered by KBL under the VT pump category. VT pumps from KBL cater to a diverse set of requirements, with flow capacities ranging from 10 m^3/hr to 45,000 m^3/hr and delivery sizes from 100 mm to 2100 mm. This extensive range allows municipalities and industries to select the most appropriate pump model based on their specific operational needs.

The session provided participants with a thorough understanding of VT pumps and their operational considerations, setting a strong foundation for subsequent sessions on troubleshooting and maintenance.

3.3 Session 3: Installation, Troubleshooting, and Maintenance (Presented by Kirloskar Brothers Limited (KBL))

The third session of the workshop, presented by Mr. Pritam Kumar from KBL, delved into the practical aspects of pump operations, troubleshooting, and maintenance. KBL team session covered the intricacies involved in the installation and upkeep of pumps of various sizes—small, medium, and large—manufactured by KBL. His presentation aimed to equip participants with the technical expertise required to ensure optimal performance and longevity of pumps, while minimizing downtime and operational disruptions.

Understanding Pump Specifications: KBL team began their session by stressing the importance of thoroughly understanding the specifications of each pump, as indicated on its nameplate. He highlighted critical information such as the Best Efficiency Point (BEP), Overall Arrangement (OA) number, and other operational parameters that are essential for efficient troubleshooting and maintenance. The BEP signifies the point at which the pump operates most efficiently, offering the best balance between flow rate, head, and energy consumption. Knowing this information helps operators adjust the pump settings to maximize its performance and lifespan. Similarly, the OA number is crucial when procuring spare parts or communicating with manufacturers, as it provides a unique reference for each pump's design and configuration.

Piping—Suction and Delivery Considerations: Proper piping design and installation are vital to the stability and functionality of pumps. KBL team emphasized that both suction and delivery pipes should be anchored and supported independently of the pump itself to prevent any undue stress or pressure on the pump casing. Misalignment or excess pressure can cause deformation of the pump casing, leading to imbalance, vibration, and even pump failure. It is essential that piping is installed in a manner that maintains correct alignment and does not touch the pump casing or other components directly, which could otherwise lead to operational problems over time.

Standard Installation Procedures: The standard installation procedures recommended by KBL were discussed in detail. KBL team explained that foundation bolts must be of appropriate size and embedded securely in concrete foundations. This ensures that the baseplate is firmly fixed, preventing any movement that could misalign the pump. The baseplate must be leveled with an accuracy of within 0.05 mm per meter to avoid operational problems such as vibrations, which could lead to damage to the pump or its associated systems. He elaborated on the process of tightening the baseplate bolts to achieve uniform tension and prevent skewing or tilting during operation.

Alignment of Pumps: Proper alignment between the pump and the driver (motor) is critical to ensuring trouble-free operations and minimizing wear and tear. KBL team explained that misalignment—whether angular or parallel—can lead to a range of issues, including excessive vibration, noise, reduced bearing life, and even coupling failure. He recommended maintaining an alignment tolerance of within 0.05 mm to ensure smooth operation. Participants were advised to

regularly check alignment as part of their maintenance routine, as changes in alignment can occur over time due to settling of the foundation or thermal expansion.

Motor Power Rating and Pump Selection: Selecting the appropriate motor power rating is fundamental to achieving the desired performance from a pump. KBL team provided general guidelines for matching motor ratings with specific pump applications, noting that an undersized motor may lead to frequent tripping or overheating, while an oversized motor could result in unnecessary energy consumption. He advised that pump operators should consult the manufacturer's guidelines and conduct proper load assessments to ensure that the motor power rating aligns with the operational demands of the pump.

Identifying Troubles in Pump Operations: During the session, KBL team discussed the common issues that could hinder a pump's ability to deliver water effectively. He explained that some of these issues could be identified through careful observation of the pump's behavior. For instance, incorrect direction of motor rotation is a frequent cause of reduced pump performance. Additionally, an absence of priming, air or vapor pockets in the suction line, or insufficient submergence of the suction pipe can also prevent water from being delivered properly. Air leakage from the suction line could lead to reduced suction pressure and consequently low delivery pressure, while the presence of vapor pockets may cause cavitation and damage to the pump impeller. KBL team advised participants to inspect all these parameters systematically to identify and resolve potential issues before they escalate into major problems.

roubleshooting Guide: To aid participants in effectively managing operational issues, a comprehensive troubleshooting guide was provided. The guide contained a step-by-step approach for diagnosing and rectifying common mechanical problems encountered during installation and operation. KBL team walked through the guide, explaining how to interpret signs of trouble, such as unusual sounds, vibrations, and drops in performance, and provided insights on how to resolve these issues systematically.

Maintenance Schedule: KBL team concluded the session by presenting an ideal maintenance schedule for pumps to ensure their longevity and efficient operation. The recommended schedule included daily, monthly, quarterly, and six-monthly checks that cover a range of activities—from visual inspections to detailed performance evaluations. Regular maintenance activities include checking for leaks, inspecting the alignment of the pump and motor, verifying oil levels, and ensuring the integrity of seals and gaskets. He also emphasized that an overall maintenance should be conducted after every 4000 hours of operation, which involves a thorough examination of the pump's internal components and replacement of worn-out parts as necessary. Adhering to such a maintenance schedule, he explained, helps prevent unexpected breakdowns and extends the service life of the pump.

Overall, Session 2 provided participants with a solid understanding of the technical aspects of pump installation, troubleshooting, and maintenance. KBL team in their session detailed explanations, combined with practical tips and best practices, equipped participants with the knowledge needed to manage pumps more effectively, minimize operational disruptions, and ensure long-term reliability of their pumping systems.

3.4 Session 4: Site Visit to the Water Treatment Plant at Ichalkaranji Municipal Corporation

The fourth session of the workshop featured a comprehensive field visit to the Water Treatment Plant (WTP) at Ichalkaranji Municipal Corporation, providing participants with an opportunity to see the real-time functioning of water infrastructure systems. This session aimed to bridge the gap between theoretical knowledge and practical application, allowing the attendees to experience first-hand the operational dynamics of Vertical Turbine (VT) pumps and other critical components of a fully functioning water treatment facility.

The visit began with a detailed tour of the WTP, where participants were introduced to various stages of the water treatment process and the role of pumps at each stage. Trainers from KBL guided the group through different sections of the plant, highlighting the design and configuration of the VT pumps used in the plant's operations.

Observation of Pump Functioning: During the tour, participants had the chance to closely observe the functioning of the VT pumps. Trainers from KBL elaborated on the different modes of operation, focusing on how these pumps handle varying water levels and flow demands. The trainers provided insights into the mechanical and hydraulic aspects of the pumps, explaining how factors such as suction head, delivery pressure, and impeller speed influence the efficiency and performance of the system. Participants were shown how the pumps are integrated with other components, such as valves, piping, and control systems, to create a seamless water distribution network.

This observation was crucial for participants to understand the practical implications of the concepts they had learned in the earlier sessions, such as pump alignment, flow rates, and energy efficiency. By seeing the pumps in action, participants were able to correlate theoretical parameters like BEP and OA number with actual operational outcomes, providing a deeper understanding of these technical terms.

Interactive Q&A Session: An interactive question-and-answer session was held on-site, where participants engaged with the trainers to discuss specific operational and maintenance challenges they faced in their respective municipalities. Participants raised queries related to emergency breakdown handling, such as the steps to take when a pump stops functioning unexpectedly or when there is a sudden drop in water pressure. Trainers provided practical solutions, including strategies for identifying and troubleshooting common issues such as cavitation, impeller damage, or air leakage in the suction line.

Other questions centered on monitoring pump performance using various diagnostic tools and techniques. Trainers shared insights on how to utilize vibration meters, pressure gauges, and temperature sensors to monitor the health of the pump and detect anomalies before they escalate into serious problems. Additionally,

the trainers emphasized the importance of regularly reading and interpreting the pump's nameplate data—such as motor rating, speed, and flow capacity—to ensure that the pump is operating within its designed parameters.

Real-World Problem-Solving and Practical Applications: The field visit provided an ideal setting for participants to apply the theoretical knowledge they had acquired in the previous sessions. Being on-site at a functional WTP enabled them to witness how different components work together to ensure a smooth water supply operation. Trainers demonstrated how real-world challenges, such as fluctuating water demand, power outages, or equipment failures, are managed through a combination of preventive maintenance and rapid response protocols.

Participants also learned about the role of automation and remote monitoring systems in modern water treatment plants. The trainers showcased how control panels and SCADA systems are used to monitor pump performance, adjust flow rates, and maintain water quality standards. This exposure to advanced monitoring and control technologies highlighted the evolving nature of water management practices and encouraged participants to consider adopting similar systems in their municipalities.

Overall, the field visit to the Water Treatment Plant at Ichalkaranji Municipal Corporation provided a valuable experiential learning opportunity for participants. By observing real-time pump operations, engaging in hands-on maintenance activities, and interacting with experienced trainers, participants gained practical insights that will enable them to optimize pump performance, improve energy efficiency, and ensure reliable water supply services in their respective regions. This session served as a fitting conclusion to the workshop, reinforcing the importance of combining theoretical knowledge with practical experience to achieve sustainable water and sanitation solutions.

4 Interactive Session and Key Points Raised

The interactive session, held at the end of each presentation, provided participants with a platform to discuss their operational challenges and seek expert guidance. This open dialogue encouraged attendees to share their experiences, highlight gaps in knowledge, and explore solutions collectively. The trainers addressed these concerns by offering insights and practical recommendations, making the session a valuable opportunity for participants to deepen their understanding of pump operations and maintenance. Key points raised during these discussions are summarized below:

Training Needs:

One of the key issues raised by participants during the session was the pressing need for targeted training programs specifically designed for ground-level technicians who are responsible for managing and maintaining pump systems. While many of these technicians have a basic understanding of pump operations, participants expressed concerns that they often lack the in-depth technical knowledge required to efficiently handle more complex pump systems, perform accurate diagnostics, and carry out routine maintenance.

Participants highlighted that the current level of training provided to technicians is insufficient to meet the demands of increasingly sophisticated pump technologies. As a result, technicians often face challenges when attempting to troubleshoot issues, use diagnostic tools, or interpret technical specifications related to the pumps they manage. These gaps in knowledge not only affect the performance and longevity of the pump systems but also result in operational inefficiencies and unnecessary downtime.

To address these challenges, participants strongly advocated for the development of structured training modules that focus on the specific technical difficulties and real-world challenges encountered by technicians in the field. Such modules should include detailed training on troubleshooting techniques, practical use of diagnostic tools, and how to read and interpret pump specifications to ensure technicians can quickly and accurately address issues.

Moreover, participants suggested the importance of organizing hands-on workshops that provide technicians with practical experience in dealing with common field problems. These workshops could be complemented by refresher courses that keep technicians updated on the latest technologies and best practices in pump management. This continuous training approach would ensure that technicians are equipped to handle the evolving complexities of modern pump systems and perform their roles with greater efficiency.

By implementing these capacity-building initiatives, organizations can significantly reduce the number of operational errors, lower the downtime caused by inadequate technical knowledge, and ultimately improve the overall performance and reliability of the pump systems. Participants underscored that investing in ongoing technician training is not

only critical for maintaining the effectiveness of the pump systems but also essential for ensuring cost savings and long-term sustainability in operations.

Linkage with Manufacturers:

Participants raised concerns regarding the difficulty in sourcing genuine spare parts for

pump maintenance and repairs. They shared instances of receiving counterfeit or substandard parts that compromised the performance and lifespan of their pumps. This issue was particularly problematic for ULBs in remote areas, where access to authorized dealers is limited. The participants requested a verified list of authorized dealers and suppliers to ensure they could procure genuine components directly from the manufacturer. They expressed that having a reliable channel for obtaining original spare parts would prevent operational disruptions and reduce the risk of further damage caused by incompatible or poor-quality components. The trainers acknowledged this concern and assured participants that they would facilitate communication between ULBs and KBL's authorized dealers, thereby improving the supply chain for genuine parts.

Assembly Checks:

Another issue discussed was the challenge of performing assembly checks, particularly when pumps arrive pre-assembled at the installation site. Participants shared experiences where improper assembly resulted in misalignment, mechanical failures, or leaks, which were only discovered after the pumps were commissioned. This not only led to operational delays but also increased maintenance costs. To address these challenges, the trainers advised the participants to adopt a robust checklist-based inspection process prior to commissioning. This process would include verifying the alignment of critical components, ensuring that all bolts and connections are properly tightened, and checking for any missing or damaged parts. Implementing a systematic pre-commissioning inspection would help identify assembly faults early and ensure that the pumps are installed correctly, minimizing the risk of future failures.

Oil Replacement and Maintenance:

Participants sought clarification on the frequency and type of oil to be used for different pump models. The trainers emphasized that maintaining proper lubrication is crucial for the smooth operation and longevity of the pumps. Regular oil replacement prevents excessive wear and tear on internal components and reduces the risk of overheating and mechanical failures. The trainers recommended that oil changes be conducted after every 1000 hours of operation and specified that Grade-2 67 oil is most suitable for most VT pump models. This grade offers the necessary viscosity and lubricating properties to support the pump's operational demands. Additionally, the trainers advised regularly monitoring oil levels and checking for contamination, such as water ingress or metal particles, which could indicate potential issues within the pump's lubrication system.

Addressing Operational and Maintenance Challenges:

Participants also raised a number of operational challenges they face in their daily routines, such as managing pumps during

power fluctuations, dealing with equipment failures, and ensuring compliance with safety protocols. The trainers provided practical advice on handling these situations, stressing the importance of preventive maintenance and regular performance monitoring. They encouraged participants to maintain detailed logs of operational parameters, such as pressure, temperature, and vibration levels, to detect anomalies early. By tracking these metrics, technicians can identify emerging issues before they escalate into major problems, thus avoiding costly repairs and minimizing service interruptions. Trainers also suggested adopting automated monitoring systems where possible to streamline the process of tracking and analyzing performance data.

Ensuring Effective Communication with Manufacturers:

The participants discussed the need for a streamlined communication channel with manufacturers for reporting issues, seeking technical assistance, and providing feedback. They proposed establishing a dedicated helpline or online portal where ULBs can directly connect with technical experts from KBL. This would not only expedite the resolution of technical issues but also allow manufacturers to gain a better understanding of the practical challenges faced by ULBs, leading to improved product support and design modifications based on real-world feedback.

Establishment of Standard Operating Procedures (SOPs):

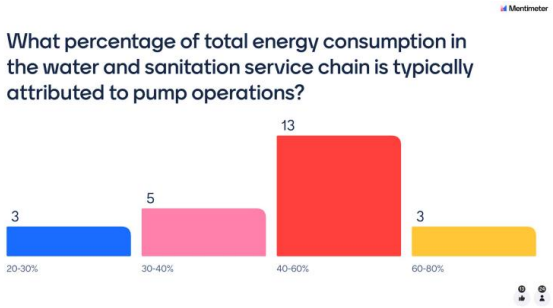
Concern: The participants and trainers agreed on the importance of developing and adhering to Standard Operating Procedures (SOPs) for various aspects of pump management, including installation, commissioning, troubleshooting, and maintenance. SOPs serve as a guideline for technicians, ensuring consistency in operations and reducing the likelihood of errors. Participants suggested the creation of a comprehensive SOP manual that includes detailed instructions for different pump models, troubleshooting charts, and safety protocols. Such a manual would act as a valuable reference document, particularly for new technicians or those with limited experience in handling advanced pump systems.

Overall, the interactive session provided a conducive environment for open dialogue, enabling participants to express their concerns and receive expert guidance tailored to their specific contexts. The trainers addressed each query with practical solutions and emphasized the importance of continuous learning and adherence to best practices in pump

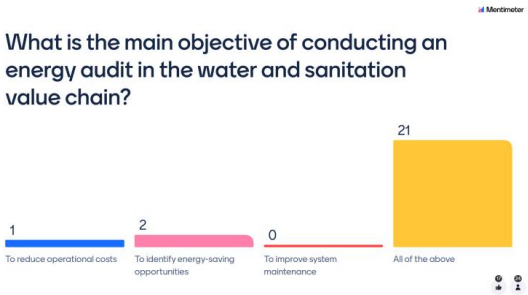
operations and maintenance. This collaborative problem-solving approach fostered a sense of community among the participants and highlighted the value of shared experiences in overcoming common challenges in the water and sanitation sector.

5 Feedback from the workshop

At the end of the workshop, a feedback session was conducted using the interactive tool Mentimeter to capture participants' opinions and suggestions in real-time. This digital platform enabled participants to share their thoughts anonymously and express their satisfaction levels with various aspects of the workshop. Participants were asked to rate the content, delivery, and overall organization of the sessions. The majority expressed high satisfaction with the technical knowledge imparted by the trainers, particularly appreciating the clarity and depth of the sessions on installation, troubleshooting, and maintenance. Questions asked and reply given by participants is as follows:

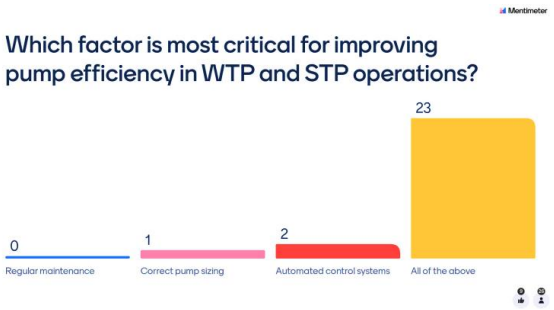


The poll results indicate that most participants (21 respondents) view the objective of an energy audit in the water and sanitation value



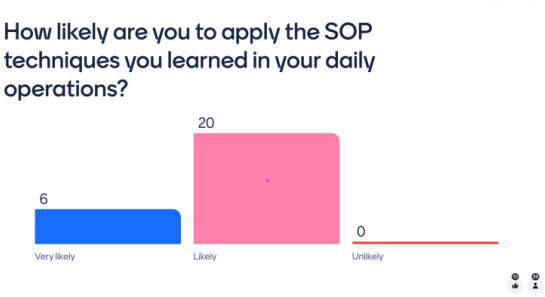
chain as multi-faceted, encompassing **reducing operational costs, identifying energy-saving opportunities, and improving system maintenance**. This highlights a comprehensive understanding of the audit's benefits. While two participants focused on energy-saving opportunities specifically, only one selected reducing operational costs, and none chose system maintenance alone. Overall, the results reflect a recognition that energy audits serve multiple purposes, contributing to both financial and operational efficiency.

The poll results suggest that the majority of participants (13 respondents) believe that **40-60%** of total energy consumption in the water and sanitation service chain is typically attributed to pump operations. A smaller number of participants (5 respondents) estimated the range to be **30-40%**, while 3 respondents each thought the percentage was either **20-30%** or **60-80%**. This indicates a general consensus around the **40-60% range**,

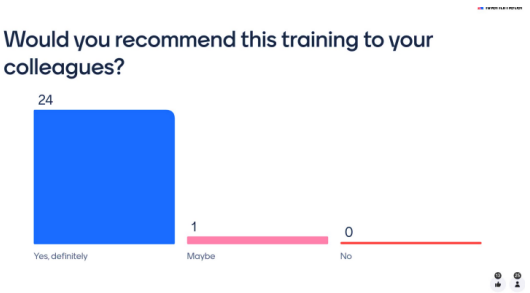


highlighting the significant role of pumps in the overall energy consumption of water and sanitation systems.

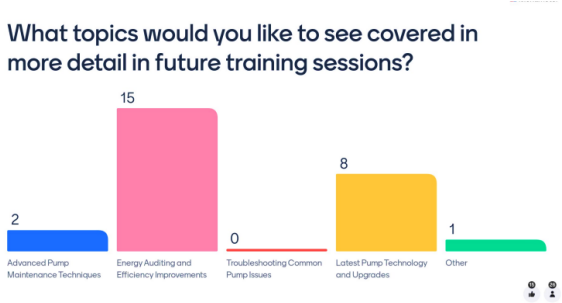
This question clearly show that the majority of participants (23 respondents) believe that **all factors**—regular maintenance, correct pump sizing, and automated control systems—are critical for improving pump efficiency in Water Treatment Plants (WTP) and Sewage Treatment Plants (STP). This suggests a holistic approach is necessary to enhance pump performance. Only a small number of participants (2 and 1) singled out automated control systems and correct pump sizing as the most important, while no one viewed regular maintenance alone as sufficient. This reinforces the idea that pump efficiency relies on a combination of factors.



From the responses provided by participants, it is evident that most are inclined to apply the SOP techniques in their daily operations. Specifically, 20 participants (the majority) indicated that they are "likely" to do so, while 6 participants expressed even stronger confidence, stating they are "very likely" to apply the techniques. Notably, no participants selected "unlikely," which suggests a positive reception and readiness to integrate the learned SOP methods into their regular workflows.



The feedback from participants suggests overwhelming support for the training. Out of 25 participants, 24 stated they would "definitely" recommend the training to their colleagues, while only 1 person expressed uncertainty with a "maybe." No one indicated that they would not recommend the training, highlighting its perceived value and

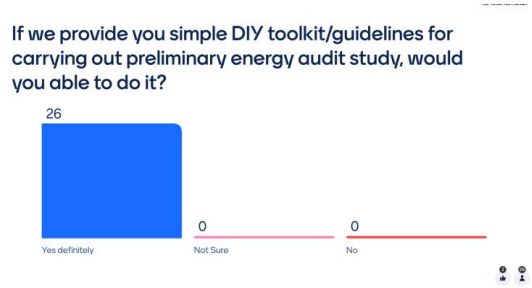


effectiveness.

The participants expressed a strong preference for certain topics to be covered in more detail during future training sessions. The most popular topic, with 15 votes, is "Energy Auditing and Efficiency Improvements," indicating a high level of interest in optimizing energy use and enhancing efficiency in operations. This is followed by "Latest Pump Technology and Upgrades," which garnered 8 votes, suggesting participants are keen to stay updated on technological advancements in pump systems.

"Advanced Pump Maintenance Techniques" received 2 votes, showing some interest in deepening knowledge in this area, while "Troubleshooting Common Pump Issues" surprisingly received no votes, implying that participants may feel sufficiently confident in

this aspect or prefer to focus on other areas. Lastly, 1 participant selected "Other," potentially indicating a need for a different or more specialized topic not listed. This feedback can guide the planning of future training to align with the participants' interests and needs.



The survey shows that **all 26 respondents** are confident they can conduct a preliminary energy audit using the provided DIY toolkit or guidelines, with no one selecting "Not Sure" or "No."

Key points:

1. **High readiness:** All respondents are confident, showing strong interest and capability.
2. **No uncertainty:** The absence of "Not Sure" or "No" responses suggest clear understanding and willingness.
3. **Toolkit success:** The toolkit is perceived as user-friendly and effective, indicating a good fit for future use.

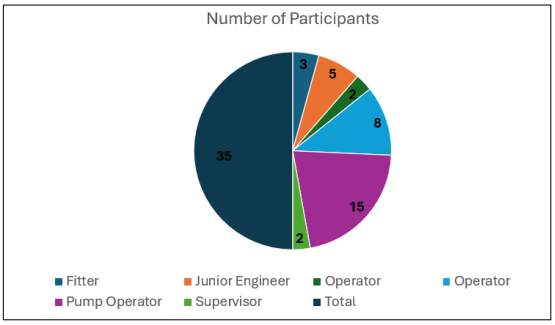
The workshop yielded highly positive results, demonstrating a strong understanding and readiness among participants to apply energy audit techniques and SOPs in pump operations.

Key Points:

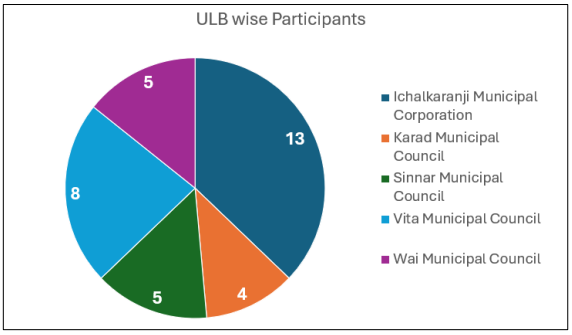
1. **Comprehensive Understanding:** Most participants recognize the multi-faceted objectives of energy audits, linking them to cost savings, energy efficiency, and system maintenance.
2. **Pump Efficiency Focus:** The majority agree that improving pump performance in WTPs and STPs requires a combination of factors—maintenance, correct sizing, and automation.
3. **High Adoption Likelihood:** Almost all participants are eager to integrate the SOP techniques into their daily work, showcasing strong acceptance of the training content.
4. **Energy Consumption Insight:** There is consensus that pump operations account for 40-60% of energy use in the water and sanitation service chain, emphasizing the importance of focusing on pump efficiency.
5. **Training Satisfaction:** Nearly all participants would recommend the training, highlighting its effectiveness and perceived value.
6. **Future Interests:** Participants expressed interest in further exploring energy auditing, efficiency improvements, and the latest pump technology in future sessions.

Overall, the workshop successfully equipped participants with valuable knowledge and tools, setting the stage for improved energy efficiency and operational effectiveness in water and sanitation systems.

6 Insights from Participation



The SOP training workshop for engineers and pump operators in Ichalkaranji had a total of 65 participants. The majority were Fitters (35), followed by Pump Operators (15), indicating that these roles had the highest interest or need for training. Operators (8) and Junior Engineers (5) had moderate participation, while Supervisors (2) and Engineers (2) were the smallest groups. This suggests the training was most relevant to Fitters and Pump Operators, with lower attendance from Supervisors and Engineers, potentially indicating a gap that could be addressed in future workshops.



The graph shows ULB-wise participation in the SOP training workshop for engineers and pump operators held in Ichalkaranji. Ichalkaranji Municipal Corporation had the highest number of participants (13), followed by Sinnar Municipal Council with 8 participants. Wai and Vita Municipal Councils each had 5 participants, while Karad Municipal Council had the lowest attendance with 4 participants. This suggests that Ichalkaranji Municipal Corporation had a strong representation, while participation from Karad was minimal.

The SOP training workshop in Ichalkaranji demonstrated strong engagement from Fitters and Pump Operators, highlighting the importance of these roles in maintaining operational standards. There was less involvement from Supervisors and Engineers, indicating a potential need to encourage more balanced participation across all roles in future workshops. ULB-wise, Ichalkaranji Municipal Corporation showed commendable involvement, while other councils participated to varying degrees. This suggests that while some municipalities are highly engaged in capacity-building efforts, others may benefit from additional outreach and encouragement to enhance their participation and training impact.

CENTER FOR WATER AND SANITATION

The Center for Water and Sanitation (CWAS) is a part of CEPT Research and Development Foundation (CRDF) at the CEPT University in Ahmedabad, India. CWAS undertakes action-research, implementation support, capacity building and advocacy in the field of urban water and sanitation. Acting as a thought catalyst and facilitator, CWAS works closely with all levels of governments - national, state and local to support them for delivery of water and sanitation services in an efficient, effective and equitable manner.

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