

Water Supply & Sanitary Engineering (DI05006021)

Unit 10: Maintenance of Sewage System

Lecture 42: Maintenance Equipment, Selection, and Safety
Measures

GTU Diploma Engineering

Agenda

- Categories of Sewer Maintenance Equipment
- Selection Criteria for Equipment
- Hazards in Sewer Maintenance
- Confined Space Entry Protocols
- Gas Detection and Ventilation
- Personal Protective Equipment (PPE)
- Emergency Rescue and First Aid

Categories of Maintenance Equipment

- Hand Tools: Picks, shovels, manhole hooks, and hand-operated snakes for minor, accessible issues.
- Mechanical Tools: Power rodders and bucket machines for heavy blockages and grit removal.
- Hydraulic Equipment: High-velocity hydro-jetters and vacuum trucks (Vactor trucks) for washing and debris extraction.
- Inspection Equipment: CCTV crawlers, push cameras, and sonar equipment for submerged lines.
- Safety Equipment: Gas monitors, tripods, winches, harnesses, and ventilators.

Selection Criteria for Equipment

- Nature of the Blockage: Is it soft (grease/sludge) or hard (roots/debris)? Hydro-jets for grease, root saws/rodders for roots.
- Pipe Diameter: Small pipes (under 200mm) may only need push cameras and small rodders. Large interceptors require bucket machines and tractor CCTV.
- Pipe Material & Condition: High-pressure jetting might damage older, fragile clay or concrete pipes.
- Accessibility: Can a large vacuum truck reach the manhole? If in an easement or backyard, portable equipment is required.
- Cost and Availability: Balancing the capital cost of specialized machinery against the frequency of use.

Vacuum and Combination Trucks

- Combination Trucks (Combo Trucks) are the workhorses of modern sewer maintenance.
- They combine a high-pressure water jetter (to break up debris) and a powerful vacuum system (to suck up the loosened debris).
- Reduces manual labor significantly and keeps workers above ground, out of the hazardous sewer environment.
- Ideal for cleaning catch basins, lift stations, and clearing major main-line blockages.

Hazards in Sewer Maintenance

- Atmospheric Hazards: Toxic gases (H_2S), explosive gases (Methane), and Oxygen deficiency.
- Biological Hazards: Exposure to raw sewage carrying pathogens like E. coli, Hepatitis A, and Tetanus.
- Physical Hazards: Slips, trips, falls into manholes, and engulfment by sudden surges of wastewater.
- Ergonomic & Mechanical: Heavy lifting (manhole covers), operating high-pressure machinery, and traffic hazards (working in roadways).

Atmospheric Hazards: The Silent Killers

- Hydrogen Sulfide (H_2S): Smells like rotten eggs at low levels, but paralyzes the olfactory nerves at high levels. Highly toxic and heavier than air (settles at the bottom).
- Methane (CH_4): Odorless, highly explosive, and can displace oxygen.
- Carbon Monoxide (CO): Odorless, toxic gas often from engine exhaust near the manhole.
- Oxygen Deficiency: Normal air is 20.9% oxygen. Levels below 19.5% are considered dangerous and can cause asphyxiation.

Confined Space Entry (CSE) Protocols

- Definition: A space large enough to enter, has limited entry/exit, and is not designed for continuous occupancy (e.g., Manholes, Pump Stations).
- Permit Required: A formal checklist must be completed and authorized before entry.
- Role Assignment: Requires an Entrant (person going in) and an Attendant/Top-man (person staying outside to monitor).
- Continuous Monitoring: Atmospheric conditions must be checked before entry and monitored continuously while work is ongoing.

Gas Detection and Ventilation

- Multi-Gas Monitors: Portable devices worn by workers that continuously measure O₂, H₂S, CO, and Lower Explosive Limit (LEL) for combustible gases.
- Pre-Entry Testing: The atmosphere must be tested at various depths (top, middle, bottom) before opening the cover entirely.
- Ventilation (Purging): Forced air blowers are used to introduce clean air into the manhole and expel hazardous gases before and during entry.
- The blower intake must be placed upwind and away from vehicle exhaust to avoid blowing CO into the manhole.

Personal Protective Equipment (PPE)

- Body Protection: Tyvek suits or waterproof waders to protect against sewage contact.
- Hand & Foot Protection: Heavy-duty rubber gloves (often worn over cut-resistant gloves) and steel-toed rubber boots.
- Head & Face: Hard hats, safety glasses, and sometimes full-face shields to protect against high-pressure spray back.
- Respiratory Protection: If ventilation is insufficient, Self-Contained Breathing Apparatus (SCBA) or supplied-air respirators are required.
- Visibility: High-visibility safety vests, especially when working near traffic.

Fall Protection and Retrieval Systems

- Full-Body Harness: Worn by the entrant at all times inside the confined space.
- Tripod and Winch: Set up over the manhole. The lifeline from the winch is attached to the D-ring on the worker's harness.
- Non-Entry Rescue: If the entrant collapses (e.g., from gas exposure), the attendant uses the winch to crank them out immediately.
- Prevents the attendant from becoming a secondary victim, which is a leading cause of confined space fatalities.

Traffic Control and Site Safety

- Manholes are frequently located in the center of busy streets.
- Proper Traffic Control Plans (TCP) must be implemented.
- Includes the use of advance warning signs, traffic cones, barricades, and sometimes flaggers.
- The work zone must provide a safe buffer space between moving vehicles and the open manhole.

Emergency Preparedness and Training

- Regular Training: Workers must be certified in confined space entry, CPR, and first aid.
- Vaccinations: Workers should have up-to-date vaccinations for Hepatitis A, Hepatitis B, Tetanus, and Polio.
- Emergency Action Plan (EAP): A clear protocol on who to call and what to do if an accident occurs.
- Equipment Maintenance: Safety equipment like gas monitors must be calibrated regularly (bump testing) to ensure accuracy.

Summary

- Equipment selection depends on the blockage type, pipe size, and location (e.g., combo trucks vs. hand rodders).
- Sewer maintenance presents severe atmospheric, biological, and physical hazards.
- Hydrogen Sulfide and Methane are deadly gases requiring continuous monitoring and forced ventilation.
- Confined Space Entry protocols dictate the use of permits, attendants, harnesses, and tripod retrieval systems.
- Comprehensive PPE and strict traffic control are mandatory to protect workers.

Course Conclusion

- This concludes Unit 10 and the core syllabus for Water Supply & Sanitary Engineering.
- We have traced the journey of water from its source, through treatment and distribution.
- And followed wastewater from collection, through appurtenances, to maintenance.
- Next steps: Comprehensive course review, exam preparation, and final assessments.