Exploring Density and Viscosity

PIPE TRADES

GRADES	LEARNING OBJECTIVE	CONCEPTS
• Grade 8	Students will investigate the relationship between density and the viscosity of liquids in plumbing systems.	• Density • Viscosity • Mixtures • Pure substances • Solutions • Properties of fluids– mass, volume

Curriculum Connections

GRADE 8 SCIENCE

Learning outcomes for Science, Technology and Society (STS) and Knowledge:

- Investigate and describe fluids used in technological devices and everyday materials
  - Investigate and identify examples of fluids in household materials, technological devices, living things and natural environments
  - Distinguish among pure substances, mixtures, and solutions, using common examples (e.g., identify examples found in households)
- Investigate and compare the properties of gases and liquids and relate variations in their viscosity, density, buoyancy, and compressibility to the particle model of matter
  - Investigate and compare fluids based on their viscosity and flow rate and describe the effects of temperature change on liquid flow
  - Observe the mass and volume of a liquid and calculate its density using the formula d = m/v (Note: This outcome does not require students to perform formula manipulations or solve for unknown terms other than the density)
  - Compare densities of materials and explain differences in the density of solids, liquids, and gases using the particle model of matter
  - Describe methods of altering the density of a fluid and identify and interpret related practical applications (e.g., describe changes in buoyancy resulting from increasing the concentration of salt in water)

Description

Students delve into an investigation of the relationship between density and viscosity in plumbing systems. The lesson begins by introducing the role of density in plumbing efficiency. Students then engage in hands-on experiments, measuring liquids' mass, calculating relative density, predicting viscosity, and observing fluid behavior in a simulated plumbing setup. The session concludes with an analysis of predictions, actual observations, and discussions about the broader implications of fluid viscosity within plumbing systems. This immersive exploration empowers students to apply density and viscosity principles to practical plumbing scenarios.

Understanding the interplay between density and viscosity in plumbing systems is vital for plumbing professionals as it directly impacts the efficiency and functionality of fluid flow within pipes. This knowledge enables plumbers to design optimal layouts, diagnose issues related to fluid behavior, and implement effective solutions for maintaining efficient water supply and drainage systems.

TIME

- 50–60 minutes

MATERIALS

- Pipe stand
- Valves
- Bottles of syrup, oil, and water
- Measuring cups
- Scale
- Small 1" pipe
- Drain bucket
- Density sheet (including formulas and space for recording measurements and observations)
- Pencil and paper

Procedure

PREPARATION

- Set up pipe stands at stations with all required tools.
    - Watch the Lethbridge Polytechnic Fluid Properties videos.

STEPS

1. Introduction (10 minutes)

- Begin by discussing the concept of density and its relevance in plumbing systems.
- Explain that density plays a role in the flow rates of liquids through pipes, affecting the efficiency of plumbing systems.
- Engage students in a brief discussion about the factors that can influence the flow rates of liquids in plumbing, such as density, viscosity, and pipe diameter.

2. Experiment setup (10 minutes)

- Set up the pipe stand and close all the valves to simulate a plumbing system.
- Gather bottles of syrup, oil, and water, which represent different fluids commonly encountered in plumbing.
- Distribute measuring cups to each group of students.
- Instruct students to measure 2 cups of each liquid and record the mass of the liquids on the density sheet using a scale. Zero scale with measuring cup before pouring.
- Once the measurements are recorded, have students pour each liquid into the small 1" pipe and observe the liquids separate from each other.

3. Calculation of relative density (10 minutes)

- Instruct students to use the recorded mass to calculate the relative density of each liquid using the following formula: Relative Density = Mass / Volume
- Guide students through the calculations, emphasizing the relevance of density in understanding the behavior of fluids in plumbing systems.

4. Predictions and hypotheses (5 minutes)

- Ask students to make predictions about which liquid they think will have the highest viscosity in a plumbing system.
- Encourage students to explain their reasoning based on their understanding of density and the influence of fluid properties on plumbing performance.
- Have students record their predictions on the density sheet.

5. Viscosity observation (15 minutes)

- Set up a drain bucket under the valve of the pipe.
- Instruct students to open the valve to allow the liquids to flow fully and observe the viscosity.
- Have students record their observations on the density sheet, including which liquid was the most/least viscous.

6. Analysis and conclusion (10 minutes)

- Discuss the observations as a class and compare the actual viscosities with the predictions made by the students.
- Guide students in analyzing the results and connecting them to the concept of density in the context of plumbing systems.
- Facilitate a class discussion on the implications of fluid viscosity in plumbing, such as the impact on water supply, drainage, and overall system efficiency.

7. Reflection and extension (5 minutes)

- Ask students to reflect on what they've learned about density and viscosity of liquids in plumbing during the activity.
- Encourage them to think about how these concepts are relevant to real-world plumbing situations, such as designing efficient pipe layouts, understanding fluid behavior, and troubleshooting plumbing issues.

Assessment suggestions

ASSIGNMENT SUGGESTION 1

Evaluate students' accuracy and understanding of the density calculations through the recorded measurements.

- Review students' density calculations to assess if they have correctly used the mass and volume data to determine the relative density of each liquid.
- Look for evidence of correct formula application, proper unit conversions, and accurate calculations.
- Assess students' comprehension of the concept of density and its relevance to the behavior of fluids in plumbing systems.

Web resources

- Fluid Properties: Overview
- Fluid Properties: Density and Viscosity

Contributors

Spencer Wenzel, Colton Garner, Logan Fulwiler, Andrew Ruffle, Warren Anderson, Roy Mugisha