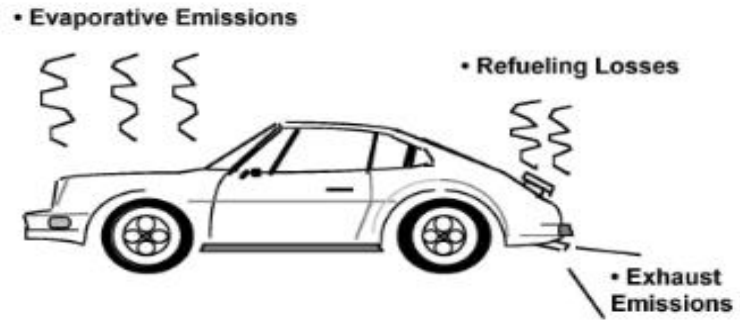
Automotive Mechanics

Level V

Based on December, 2024 Curriculum Version II



Module Title: - EIS AUM5 05 1224: Manage Environmental Protection Process

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Prepared by: Ministry of Labor and Skill

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Table of Contents

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Acronym

EMP	Environmental management Protection
CO	Carbon monoxide
HC	Hydro Carbon
EMP	Environmental management plan
NO_X	Oxide of Nitrogen
CO_2	Carbon Dioxide
PPM	Particulate per mint
ICE	Internal compassion Engine
O_2	Oxygen
VOC	volatile organic compounds

Introduction to module

On road transportation, using motor vehicles has played a vital in economic development of different countries across the globe. Providing adequate preventive as well as corrective maintenance of these vehicles will support in effective utilization their potential. Accordingly, a carrier of repairing automotive body is essential, which requires standard training and qualification. Hence, this module is prepared to support training of specific unit of competence, which contains how to repairing automotive body and painting work . In addition, it involves minor inspections to identify deviations from correct operation, removal, disassembly and fitting procedures for main and interrelated components following manufacturer specification.

This module specifies the outcomes required to manage environmental management plan practices and processes as part of the organization's overall management system

This module covers the units:

- Introduction to environmental protection
- environmental plan and management
- Conduct vehicle emission

Learning Objective of the Module

- Introduction to environmental protection
- environmental plan and management
- Conduct vehicle emission
- Module Instruction

For effective use this modules trainees are expected to follow the following module instruction:

1. Read the information written in each unit
2. Accomplish the Self-checks at the end of each unit
3. Perform Operation Sheets which were provided at the end of units
4. Do the "LAP test" giver at the end of each unit and
5. Read the identified reference book for Examples and exercise

Unit-one: introduction to environmental protection

This unit is developed to provide you the necessary information regarding the following content coverage and topics:

- Definition of environmental protection
- Key concept
- Global and regional environment challenge

This unit will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Understand of environmental protection
- Key concept
- Global and regional environment challenge

1.1 Definition of environmental protection

Environment protection is the practice of protecting the natural environment by individuals, groups and governments.[1] its objectives are to conserve natural resources and the existing natural environment and, where it is possible, to repair damage and reverse trends.

due to the pressures of overconsumption, population growth and technology, the biophysical environment is being degraded, sometimes permanently. this has been recognized, and governments have begun placing restraints on activities that cause environmental degradation. since the 1960s, environmental movements have created more awareness of the multiple environmental problems. there is disagreement on the extent of the environmental impact of human activity, so protection measures are occasionally debated.

Environmental Protection includes programs and services that are aimed at reducing risks to the environment from contaminants such as hazardous materials and wastes, fuels, and oils

One of the most common environmental protection definitions involves organisations and governments taking steps in order to protect the natural world.[1] Sometimes referred to as "environmental preservation", this concept has become even more important in these challenging times. Let us examine environmental protection from a practical point of view before addressing a handful of ways to save the environment as well as what the future may have in store.

Environmental protection does not represent an overnight "cure-all" for the issues that the world is currently facing. On the contrary, the very notion of environmental protection is longitudinal in nature. This is another way of saying that the solutions themselves will take time to implement. It therefore stands to reason that espousing a proactive stance is the best way to begin; even though the effects might not be witnessed overnight.

Environment can be defined as a sum total of all the living and non-living elements and their effects that influence human life. While all living or biotic elements are animals, plants,

forests, fisheries, and birds, non-living or abiotic elements include water, land, sunlight, rocks, and air. Primary Goals of Environmental Protection

is already obvious that environmental protection is concerned with the ability to save our environment, another primary theory involves the relationship of humans with the environment. This is why industry experts also cite the aim to improve our very existence while simultaneously conserving vital resources that may take hundreds (or even thousands) of years to restore once they have become depleted.

As global awareness of environmental protection continues to grow, there is no doubt that governments will take additional steps to ensure a bright future. However, companies must also adopt their own environmental protection policies to remain one step ahead of the curve.

1.1.1. Importance of Environmental Protection

1. Biodiversity Conservation: Protecting ecosystems and species from extinction is vital for maintaining biodiversity, which supports ecosystem services such as pollination, water purification, and climate regulation.

2. Climate Change Mitigation: Addressing climate change through sustainable practices helps reduce greenhouse gas emissions, thus minimizing global warming and its associated impacts on weather patterns, sea levels, and ecosystems.

3. Public Health: A clean environment is essential for human health. Reducing pollution and protecting natural resources contributes to better air and water quality, reducing the incidence of diseases related to environmental factors.

4. Economic Stability: Healthy ecosystems provide essential services that support economies, including agriculture, fisheries, tourism, and recreation. Environmental degradation can lead to economic losses and increased costs for communities.

5. Cultural and Aesthetic Value: Natural landscapes and biodiversity hold cultural significance for many communities and contribute to the overall quality of life by providing recreational opportunities and aesthetic enjoyment.

1.1.2. Function of Environmental Protection

The functions of environmental protection are multifaceted and aim to safeguard the environment while promoting sustainable development. Here are some key functions:

- Preservation of Natural Resources: Environmental protection helps conserve natural resources such as water, air, soil, and biodiversity, ensuring their availability for future generations.
- Pollution Control: It involves regulating and reducing pollutants released into the air, water, and soil to minimize environmental degradation and protect public health.
- Biodiversity Conservation: Protecting ecosystems and wildlife species is essential for maintaining biodiversity, which supports ecosystem resilience and functioning.
- Climate Change Mitigation: Environmental protection efforts aim to reduce greenhouse gas emissions and promote practices that help combat climate change and its adverse effects.
- Sustainable Development: It promotes practices that balance economic growth with environmental stewardship, ensuring that development meets present needs without compromising future generations.
- Public Health Protection: By controlling pollution and managing waste, environmental protection helps safeguard public health from environmental hazards and diseases.
- Ecosystem Services Maintenance: Protecting the environment ensures the continued provision of ecosystem services, such as clean water, pollination, and climate regulation, which are vital for human well-being.
- Regulatory Compliance: Establishing and enforcing environmental laws and regulations ensures that individuals, businesses, and governments adhere to standards that protect the environment.
- Community Engagement and Education: Promoting awareness and understanding of environmental issues encourages communities to participate in conservation efforts and adopt sustainable practices.

- Research and Innovation: Supporting scientific research helps develop new technologies and methods for environmental protection, leading to more effective solutions for environmental challenges.
- Disaster Risk Reduction: Environmental protection strategies can help mitigate the impacts of natural disasters (e.g., floods, landslides) by maintaining healthy ecosystems that provide natural barriers.

These functions are interconnected and collectively contribute to a healthier planet and improved quality of life for current and future generations.

1.2 Key concept environmental protection

Environmental protection refers to the practices and policies aimed at preserving the natural environment and promoting sustainability. Key concepts include:

a. **Sustainability**: Balancing ecological, social, and economic needs to ensure that resources are available for future generations.
b. **Conservation**: The responsible management of natural resources, including wildlife, forests, water, and land, to prevent depletion and degradation.
c. **Pollution Prevention**: Reducing or eliminating the release of pollutants into the environment through cleaner production methods and sustainable practices.
d. **Biodiversity**: Protecting the variety of life on Earth, including ecosystems, species, and genetic diversity, which is crucial for resilience and ecological balance.
e. **Climate Change Mitigation**: Efforts to reduce greenhouse gas emissions and enhance carbon sinks to combat global warming and its impacts.
f. **Renewable Resources:** Promoting the use of energy sources that are naturally replenished, such as solar, wind, and hydroelectric power.
g. **Environmental Justice:** Ensuring that all communities have equal access to a healthy environment and that no group bears a disproportionate share of environmental harms.

h. **Regulatory Frameworks:** Establishing laws and regulations that protect the environment, such as the Clean Air Act and Clean Water Act in the United States.

i. **Public Awareness and Education**: Raising awareness about environmental issues and encouraging individuals and communities to engage in sustainable practices.

j. **Ecosystem Services:** Recognizing the benefits that natural ecosystems provide to humanity, such as clean air, water purification, pollination of crops, and climate regulation.

These concepts are interconnected and form the foundation for effective environmental protection strategies at local, national, and global levels.

1.2.1 Sustainability and environmental protection

Sustainability refers to the ability to meet the needs of the present without compromising the ability of future generations to meet their own needs. It encompasses a balanced approach to economic growth, social inclusion, and environmental protection. Environmental protection, on the other hand, focuses specifically on safeguarding the natural environment from degradation and ensuring the health of ecosystems. Together, these concepts are crucial for fostering a resilient planet and promoting a high quality of life for all living beings.

- **Key Principles of Sustainability**

1. **Interconnectedness:** Recognizing that environmental, social, and economic systems are interconnected and that actions in one area can have far-reaching impacts in others.

2. **Equity:** Ensuring fair access to resources and opportunities for all individuals, communities, and nations, thereby promoting social justice.

3. **Precautionary Principle**: Taking preventive action in the face of uncertainty, particularly when there is a risk of serious or irreversible harm to the environment or human health.

4. **Resource Efficiency:** Using resources—such as water, energy, and raw materials—more efficiently to minimize waste and reduce environmental impact.

5. **Long-term Perspective:** Planning and decision-making that consider long-term impacts rather than short-term gains, ensuring that economic growth does not come at the expense of environmental degradation.

1.2.2 Environmental impact

Fixing collisions makes a big environmental mess. It creates a lot of waste and pollution. At Miracle Body and Paint, we work hard to lessen this damage. We use green methods for repairs. This means when you choose us, you help keep the earth safe. Plus, your car looks great again after the repair.

- Collision repairs have a considerable environmental impact due to waste and emissions.
- Traditional repair methods often involve harmful chemicals and paints, releasing toxic emissions.
- Eco-friendly collision repairs actively reduce environmental burdens.
- Using sustainable practices and materials significantly reduces emissions, waste, and energy consumption.
- Choosing water-based paints and recycled/refurbished parts enhances your car's appearance and protects it while creating a safer driving environment.

Fig 1.1 vehicle environmental impact

1.2.3 Pollution control

Effective pollution control is essential for protecting public health, preserving natural resources, and ensuring a sustainable future.

- **Types of Pollution**

1. Air Pollution: Caused by emissions from vehicles, industrial processes, and burning fossil fuels. Common pollutants include particulate matter (PM), nitrogen oxides (NOx), sulfur dioxide (SO2), carbon monoxide (CO), and volatile organic compounds (VOCs).

2. Water Pollution: Results from the discharge of harmful substances into water bodies. Sources include agricultural runoff (pesticides and fertilizers), industrial effluents, sewage, and plastic waste.

3. Soil Pollution: Caused by the contamination of soil with hazardous chemicals, heavy metals, and waste materials. Common sources include industrial waste disposal, agricultural chemicals, and improper waste management.

4. Noise Pollution: Arises from excessive noise from transportation, industrial activities, and urbanization, leading to disturbances in human and wildlife habitats.

5. Light Pollution: Refers to excessive or misdirected artificial light that disrupts ecosystems and affects human health.

- **Importance of Pollution Control**

• Public Health: Reducing pollution levels decreases the incidence of respiratory diseases, cardiovascular problems, and other health issues linked to environmental contaminants.

• Ecosystem Protection: Pollution control helps maintain biodiversity by protecting habitats and preventing the degradation of ecosystems.

• Economic Benefits: Cleaner environments can lead to increased property values, enhanced tourism, and reduced healthcare costs associated with pollution-related illnesses.

• Sustainable Development: Effective pollution control is essential for achieving sustainable development goals (SDGs) and ensuring that natural resources are available for future generations.

- **Strategies for Pollution Control**

1. **Regulatory Frameworks:** Implementing laws and regulations that set limits on emissions of pollutants from industries and vehicles. Enforcing environmental standards to ensure compliance with pollution control measures.

2. Monitoring and Assessment: Regularly monitoring air and water quality to identify pollution sources and assess compliance with environmental standards. Conducting environmental impact assessments (EIAs) for new projects to evaluate potential pollution risks.

3. Pollution Prevention: Encouraging industries to adopt cleaner production techniques that minimize waste generation and resource consumption. Promoting eco-friendly practices such as green chemistry and sustainable materials management.

4. Waste Management: Implementing effective waste management practices, including recycling, composting, and safe disposal of hazardous waste. Reducing single-use plastics and promoting alternatives to minimize plastic pollution.

5. Public Awareness and Education: Raising awareness about the impacts of pollution and the importance of environmental stewardship. Educating communities about sustainable practices, such as reducing energy consumption and proper waste disposal.

6. Technological Innovations: Investing in clean technologies that reduce emissions from industries and transportation. Developing advanced wastewater treatment systems to remove contaminants from industrial effluents before discharge.

7. Restoration Projects: Initiating programs aimed at restoring polluted sites, such as cleaning up contaminated land and rehabilitating degraded ecosystems.

8. Incentives for Sustainable Practices: Providing financial incentives or subsidies for businesses that adopt environmentally friendly practices. Supporting research and development of sustainable technologies through grants and funding opportunities.

Effective environmental pollution control is vital for safeguarding public health, protecting ecosystems, and promoting sustainable development. By implementing a combination of regulatory measures, technological innovations, public education, and community engagement, societies can significantly reduce pollution levels and their associated impacts. A collaborative approach involving governments, industries, communities, and individuals is essential for creating a cleaner, healthier environment for current and future generations. Through concerted efforts in pollution control, we can work towards a more sustainable future where both people and the planet thrive.

1.2.4 Global Environmental Challenges

1. Climate Change: Greenhouse Gas Emissions: The automotive sector is a significant contributor to CO2 emissions, primarily from internal combustion engine vehicles. Transitioning to low-emission and zero-emission vehicles is crucial.Life Cycle Emissions: Emissions from manufacturing, fuel extraction, and vehicle disposal also contribute to climate change, necessitating a holistic approach to emissions reduction.

2. Air Quality: Urban Air Pollution: Vehicles emit pollutants such as nitrogen oxides (NOx), particulate matter (PM), and volatile organic compounds (VOCs), leading to poor air quality and health issues in urban areas. Regulatory Pressure: Stricter emissions standards globally push manufacturers to innovate and reduce harmful emissions.

3. Resource Depletion: Raw Material Extraction: The production of batteries for electric vehicles (EVs) requires significant amounts of lithium, cobalt, and nickel, leading to environmental degradation and ethical concerns regarding mining practices.Sustainable Materials: There is a growing need to find sustainable alternatives for materials used in vehicle production, including plastics and metals.

4. Waste Management: End-of-Life Vehicles: The disposal and recycling of vehicles at the end of their life cycle pose environmental challenges. Effective recycling systems are needed to reclaim materials and reduce landfill waste.Battery Disposal: The rise of EVs necessitates efficient battery recycling processes to prevent environmental contamination.

1.2.5 Regional Environmental Challenges

1. Regulatory Variability: Different regions have varying emissions standards and regulations, creating challenges for global manufacturers to comply with diverse requirements while maintaining competitiveness.

2. Infrastructure Development: In many regions, inadequate infrastructure for electric vehicles (e.g., charging stations) hampers the adoption of cleaner technologies. Investments in infrastructure are necessary to support the transition to EVs.

3. Economic Factors: Regions with lower economic resources may struggle to invest in cleaner technologies or enforcement of environmental regulations, leading to continued reliance on older, more polluting vehicles.

4. Public Transportation Challenges: In many urban areas, insufficient public transportation options lead to increased reliance on personal vehicles, exacerbating traffic congestion and pollution.

5. Cultural Attitudes: Consumer preferences and cultural attitudes towards vehicle ownership and sustainability can vary significantly by region, affecting the adoption of new technologies like EVs or car-sharing services.

6. Regional Climate Impacts: Different regions face unique climate challenges (e.g., extreme weather events), influencing automotive design and manufacturing processes. For instance, vehicles may need to be adapted for hotter climates or increased flooding.

Addressing these global and regional environmental challenges in the automotive context requires collaboration among governments, manufacturers, consumers, and other

stakeholders. Innovations in technology, shifts toward sustainable practices, regulatory frameworks, and public awareness campaigns are essential for creating a more sustainable automotive industry that minimizes its environmental impact while meeting the needs of society.

Self check

Instruction ;-choose the following questions

1. Traditional environmental issues include which of the following? Please select all that apply.
   a. Natural resource conservation.
   b. Climate change.
   c. Pollution.
   d. Exploitation of maritime resources.

2. What is the tragedy of the commons?
   a. results from an inherent tension between collective and individual responsibility
   b. It can always be resolved through privatization and nationalization of the commons.
   c. It is independent of the carrying capacity of the common.
   d. All of the options given are correct.

3. What are realist approaches to environmental politics?
   a. Realist theories emphasize the role of institutions in regulating the environment
   b. Realist theories focus on questions of state power and interest.
   c. Realist theories emphasize the role played by epistemic
   d. Realist theories focus on the dissemination of environmental norms.

4. What is the 'precautionary principle'?
   a. It is German in origin.
   b. It advocates for a higher standard for environmental action.
   c. It has become increasingly popular.

d. All of the options given are correct.

5. Norms of environmental protection include which of the following options?

a. The precautionary principle.

b. The polluter pays.

c. Prior informed consent.

d. All of the options given are correct.

Unit-Two: Environmental Plan and Management
This unit is developed to provide you the necessary information regarding the following content coverage and topics: • Introduction to Environmental Plan and Management • Developing new Environmental Plan • Evaluate and monitor This unit will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to: • Introduction to Environmental Plan and Management • Perform Developing new Environmental Plan • Evaluating and monitoring

2.1. Introduction to Environmental Plan and Management

Introduction to Environmental Plan and Management in Automotive Body Repair Context The automotive body repair industry plays a crucial role in the lifecycle of vehicles, addressing damage from accidents, wear and tear, and other factors. However, this sector also presents significant environmental challenges, including waste generation, emissions, and the use of hazardous materials. As environmental awareness grows and regulatory frameworks tighten, it is essential for automotive body repair facilities to adopt effective environmental planning and management practices. This introduction outlines the importance of environmental management in this context, key objectives, and the principles that guide sustainable practices within automotive body repair operations.

Environmental planning and management are vital components for automotive body repair facilities striving for sustainability in an increasingly eco-conscious market. By adopting effective practices that prioritize pollution prevention, resource efficiency, and compliance with regulations, these businesses can not only reduce their environmental impact but also enhance their operational efficiency and reputation. As the industry evolves, integrating sustainable practices will be essential for long-term success and resilience in the face of environmental challenges.

2.1.1. Importance of Environmental Planning and Management

1. Regulatory Compliance: Automotive body repair shops must adhere to various environmental regulations concerning hazardous waste disposal, air quality standards, and chemical handling. An effective environmental management plan ensures compliance with local, state, and federal laws, reducing the risk of fines and legal issues.

2. Waste Reduction: The body repair process generates various types of waste, including paint thinners, solvents, metal scraps, and plastics. Implementing a robust environmental management plan helps identify opportunities for waste minimization and recycling, thus promoting a circular economy.

3. Resource Efficiency: Efficient use of resources such as energy and water can lead to cost savings for repair facilities. By adopting environmentally friendly practices, businesses can reduce operational costs while minimizing their ecological footprint.

4. Health and Safety: Many materials used in automotive body repair can pose health risks to workers if not handled properly. An environmental management plan includes safety protocols and training to protect employees from exposure to hazardous substances.

5. Reputation and Customer Trust: As consumers become more environmentally conscious, businesses that demonstrate a commitment to sustainability can enhance their reputation and attract environmentally aware customers. An effective environmental plan can serve as a marketing tool that distinguishes a shop from its competitors.

2.1.2. Key Objectives of Environmental Planning in Automotive Body Repair

1. Pollution Prevention: Identify sources of emissions and waste within the repair process and implement strategies to minimize or eliminate them.

2. Sustainable Material Use: Promote the use of eco-friendly materials, such as low-VOC (volatile organic compound) paints and sustainable parts sourcing, to reduce environmental impact.

3. Training and Awareness: Educate staff on environmental policies, safe handling of materials, and waste management practices to foster a culture of sustainability within the workplace.

4. Monitoring and Reporting: Establish systems for tracking environmental performance metrics, such as waste generation rates and emissions levels, to assess progress toward sustainability goals.

5. Emergency Preparedness: Develop plans for responding to environmental emergencies, such as chemical spills or accidents, to mitigate potential harm to workers and the surrounding environment.

2.1.3. Principles of Environmental Management

1. Integration: Environmental considerations should be integrated into all aspects of the body repair process, from initial assessments to final inspections.

2. Continuous Improvement: Adopt an adaptive management approach that encourages ongoing evaluation and improvement of environmental practices based on feedback and new technologies.

3. Stakeholder Engagement: Involve employees, suppliers, and customers in developing and implementing environmental initiatives to ensure broad support and collaboration.

4. Life Cycle Thinking: Consider the entire lifecycle of materials used in repairs—from sourcing to disposal—to identify opportunities for reducing environmental impacts at every stage.

5. Transparency: Maintain open communication about environmental practices with stakeholders, including customers and regulatory bodies, to build trust and accountability.

2.2. Develop new environmental management plan

Developing a new Environmental Management Plan (EMP) for an automotive body repair facility involves several key steps to ensure that the operations minimize environmental impact while complying with relevant regulations. Here's a structured approach to creating an effective EMP

Step 1: Assess Current Practices

1. Conduct an Environmental Audit: Review existing processes, materials, and waste management practices. Identify sources of pollution (e.g., VOC emissions from paints, waste solvents, water runoff).

2. Regulatory Compliance Review: Identify applicable local, state, and federal environmental regulations related to automotive repair. Assess current compliance status and identify gaps.

Step 2: Identify Environmental Aspects and Impacts

1. List Activities: Document all activities conducted in the body repair shop (e.g., painting, sanding, washing vehicles).

2. Evaluate Environmental Aspects: For each activity, identify potential environmental aspects (e.g., emissions, waste generation, resource consumption).

3. Assess Impacts: Evaluate the significance of each aspect on the environment (e.g., air quality, water quality, soil contamination).

Step 3: Set Objectives and Targets

1. Define Environmental Objectives: Establish clear, measurable objectives based on the identified impacts (e.g., reduce VOC emissions by 20% within two years).

2. Set Specific Targets: Develop specific targets to achieve the objectives (e.g., switch to low-VOC paints, implement a waste recycling program).

Step 4: Develop Action Plans

1. Identify Actions Required: List actions needed to meet the objectives and targets (e.g., training staff on proper handling of hazardous materials, installing a water reclamation system).

2. Assign Responsibilities: Designate personnel responsible for implementing each action.

3. Establish Timelines: Create a timeline for completing each action item.

Step 5: Implement the EMP

1. Training and Awareness: Conduct training sessions for staff to ensure understanding of the EMP and their roles in achieving its goals.

2. Resource Allocation: Allocate necessary resources (financial, human, and technological) to support the implementation of the plan.

3. Communication: Communicate the EMP to all stakeholders, including employees, customers, and regulatory bodies.

Step 6: Monitor and Measure Performance

1. Establish Monitoring Procedures: Develop methods to monitor progress towards objectives (e.g., regular emissions testing, waste audits).

2. Data Collection: Collect data on key performance indicators (KPIs) related to environmental performance (e.g., amount of waste generated, emissions levels).

Step 7: Review and Improve

1. Regular Reviews: Schedule regular reviews of the EMP to assess its effectiveness and identify areas for improvement.

2. Feedback Mechanism: Establish a feedback mechanism for employees to report issues or suggest improvements.

3. Continuous Improvement: Update the EMP based on monitoring results, regulatory changes, and technological advancements.

Step 8: Reporting

1. Document Results: Keep records of all monitoring activities, compliance assessments, and progress towards objectives.

2. Stakeholder Reporting: Prepare reports for stakeholders detailing environmental performance and compliance with the EMP.

3. Public Engagement: Consider sharing successes with the community to enhance transparency and demonstrate commitment to environmental plan.

By following these steps, an automotive body repair facility can develop a comprehensive Environmental Management Plan that not only complies with regulations but also promotes sustainable practices. This proactive approach can lead to reduced environmental impacts, improved operational efficiency, and enhanced reputation among customers and stakeholders.

2.3.Evaluating and Monitoring environmental plan

Evaluating and monitoring an environmental plan in the context of automotive body repair involves several key steps and considerations. This process ensures that the repair facility complies with environmental regulations, minimizes its ecological footprint, and promotes sustainable practices. Here are the main components to consider:

1. **Establish Clear Objectives**;- Define specific environmental goals such as reducing waste, minimizing emissions, conserving water, and using eco-friendly materials. Ensure objectives align with local regulations, industry standards, and company values.

2. Baseline Assessment;- Conduct an initial assessment to understand current environmental impacts. This includes:

- Energy consumption
- Waste generation (hazardous and non-hazardous)

- Water usage
- Emissions to air and water
- Identify existing practices and areas for improvement.

3. Develop an Environmental Management Plan (EMP);- Create a comprehensive EMP that outlines strategies for achieving the established objectives. Include procedures for waste management, chemical handling, recycling programs, and energy efficiency measures.

4. Training and Awareness;-Train employees on environmental policies, procedures, and best practices. Foster a culture of environmental responsibility within the organization.

5. Implementation of Practices;-

- Implement eco-friendly practices such as:
- Using water-based paints and coatings.
- Proper disposal and recycling of automotive fluids and materials.
- Implementing energy-efficient equipment and lighting.
- Reducing solvent use through improved application techniques.

6. Monitoring and Measurement;-Establish key performance indicators (KPIs) to measure progress against environmental objectives. Regularly collect data on waste generation, energy use, emissions, and compliance with regulations. Use tools like audits and inspections to assess adherence to the EMP.

7. Reporting and Documentation;- Maintain accurate records of environmental performance and compliance. Prepare regular reports detailing progress toward goals, challenges faced, and corrective actions taken.

8. Review and Continuous Improvement;- Conduct periodic reviews of the EMP to assess effectiveness and identify areas for improvement. Engage stakeholders (employees, customers, community) in feedback processes. Adapt practices based on new technologies, regulatory changes, or shifts in industry standards.

9. Regulatory Compliance;- Stay informed about local, state, and federal environmental regulations relevant to automotive body repair. Ensure all practices comply with regulations regarding hazardous materials, waste disposal, emissions, etc.

10. Community Engagement;- Communicate with the local community about the facility's environmental efforts. Participate in community initiatives or partnerships focused on sustainability. By systematically evaluating and monitoring these aspects, an automotive

body repair facility can effectively implement an environmental plan that reduces its impact on the environment while improving operational efficiency and compliance with regulations.

1.3.1 Method of evaluating environmental data gathering systems

Evaluating environmental data gathering systems through formal and informal reports from employees and staff involves a structured approach to ensure that the information collected is accurate, relevant, and actionable. Here are the steps you can follow to conduct this evaluation effectively:

1. Define Objectives

- Identify Goals: Determine what specific environmental metrics or issues you want to evaluate (e.g., emissions, waste management, resource usage).
- Set Criteria for Evaluation: Establish clear criteria for assessing the effectiveness of the data gathering systems (e.g., accuracy, timeliness, relevance).

2. Data Collection

- Formal Reports: Review structured reports generated by the data gathering systems. Look for consistency in data collection methods, adherence to protocols, and completeness of information.
- Informal Reports: Gather insights from employees and staff through informal conversations, surveys, or feedback sessions. This can provide context to the formal data and highlight potential issues not captured in reports.

3. Analyze Data Quality

- Accuracy: Assess whether the data collected reflects true environmental conditions. Cross-check with independent sources if possible.
- Completeness: Ensure that all necessary data points are being collected and reported.
- Timeliness: Evaluate how quickly data is reported and whether it aligns with decision-making processes.

4. Evaluate User Experience

- Ease of Use: Gather feedback from employees on the usability of the data gathering systems. Are they user-friendly? Do staff feel comfortable using them?
- Training and Support: Assess whether employees have received adequate training and support to use these systems effectively.

5. Identify Gaps and Challenges

- Barriers to Data Collection: Identify any obstacles employees face in reporting or collecting data (e.g., lack of resources, unclear procedures).
- Inconsistencies: Look for discrepancies between formal reports and informal feedback, which may indicate underlying issues.

6. Stakeholder Engagement

- Involve Staff: Engage employees in discussions about the data gathering process. Their insights can provide valuable context and highlight areas for improvement.
- Interdepartmental Collaboration: Encourage collaboration between departments to ensure a holistic view of environmental performance.

7. Recommendations for Improvement

- System Enhancements: Based on your findings, propose improvements to the data gathering systems (e.g., better technology, streamlined processes).
- Training Programs: Suggest additional training or resources for staff to improve data collection practices.
- Feedback Mechanism: Establish a regular feedback loop where employees can continuously share their experiences and suggestions.

8. Reporting Findings

- Formal Report: Compile your evaluation findings into a formal report that summarizes your analysis, conclusions, and recommendations.

- Presentation: Consider presenting your findings to stakeholders in a meeting or workshop format to encourage discussion and buy-in for proposed changes.

9. Monitor Progress

- Follow-Up: After implementing changes, monitor the effectiveness of the new systems and practices over time.
- Continuous Improvement: Create a culture of continuous improvement where data gathering practices are regularly reviewed and updated based on new insights and technologies.

By following these steps, you can effectively evaluate environmental data gathering systems using both formal and informal reports from employees and staff, leading to improved data quality and enhanced environmental performance

Self check

Instruction ;-choose the following questions

1. Which of the following is FALSE of environmental planning?

   a. It can create a win-win situation for society and the environment
   b. It takes into consideration social, political, economic and governing factors when considering development.
   c. Industrial symbiosis is an example of environmental planning
   d. It is a simple science because understanding that the needs of the environment come first is very intuitive.

2. What can be a result of environmental planning?

   a. Society can benefit by being able to use an area in productive ways and the environment wins by being able to sustain itself for future generations.
   b. New laws are created to make it harder for land to be developed.
   c. An outcome where either society or the environment will benefit, as it is impossible to have a win-win scenario.
   d. Helping society accept the fact that new generations will have to live in much less natural resources because previous generations have used them beyond reasonable measure.

3. Environmental Planning is also known as
   a. urban and regional planning
   b. city planning
   c. town and country planning
   d. human settlements planning
   e. all of the choices
4. The Four Rudiments of Environmental Planning except one:

a. humankind b. environment

c. development d. sustainability e. government

5. Objectives/Purposes of EP under Society & Community except one:

a. respond to problems/needs of society

b. balance of private needs and command collective demands

c. ensure sustainable development

d. facilitate sourcing of funds for program/project implementation

6. Objectives/Purposes of EP under Planning/Management except one:

a. Provision of national basis for reclassifying/control of land use

b. Basis for enacting zoning ordinances for balanced/orderly spatial development

c. Introduction of new planning/management trends for dynamic/responsive to needs of the

d. All

Unit-Three: Vehicle Emissions

This unit is developed to provide you the necessary information regarding the following content coverage and topics:

- Automotive Emission gases
- Emission equipment
- Testing procedure

This unit will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Understand vehicle Emission
- Emission equipment
- Performing Testing procedure

3.1. Automotive Emission Gases

Vehicle emissions refer to the pollutants released into the atmosphere as a result of fuel combustion in internal combustion engines (ICE) and other processes in vehicles. These emissions are a significant contributor to air pollution and have various adverse effects on human health, the environment, and climate change. Understanding vehicle emissions is crucial for developing strategies to reduce their impact and promote cleaner transportation technologies. Automobile emission is a constituent of air pollution. The emission is a major environmental hazard both in developing and developed countries. Exhaust gas is a major component of motor vehicle emissions and it may also come from stationary internal combustion engines. The use of solid fuels for cooking, burning waste, and traffic pollution from very old tyres are also contributing factors to air pollution. Motor vehicle is a well known main source of pollutants. It is found everywhere in the globe. Many countries have imposed different standards and test procedures showing different degree of stringency

Understanding vehicle emissions is essential for addressing air quality issues and combating climate change. By adopting cleaner technologies, implementing effective regulations, and promoting sustainable transportation practices, we can significantly reduce the environmental impact of vehicles and protect public health

3.1.1. Types of Vehicle Emissions

Vehicle emissions can be categorized into several types based on their source and composition:

A. Hydrocarbons (HC)

Hydrocarbons (HC) are unburned gasoline and are measured in parts per million (ppm). A correctly operating engine should burn (oxidize) almost all the gasoline; therefore, very little unburned gasoline should be present in the exhaust. Acceptable levels of HC are 50 PPM or less for vehicles with catalytic converter. High levels of HC could be due to excessive oil consumption caused by weak piston rings or worn valve guides. The most common cause of

excessive HC emissions is a fault in the ignition system. Items that should be checked include

- Spark plugs
- Spark plug wires
- Distributor cap and rotor (if the vehicle is so equipped)
- Ignition timing (if possible) •
- Ignition coil

B. Carbon Monoxide

Carbon Monoxide (CO) is unstable and will easily combine with any oxygen to form stable carbon dioxide (CO_2). The fact that CO combines with oxygen is the reason that CO is a poisonous gas (in the lungs, it combines with oxygen to form CO_2 and deprives the brain of oxygen). CO levels of a properly operating engine with catalytic converter should be less than 0.5%. Clogged or restricted crankcase ventilation devices such as the PCV valve, hose, and tubes can cause high levels of CO. Other items that might cause excessive CO include:

- Clogged air filter
- Incorrect idle speed
- Too-high fuel-pump pressure

C. Carbon Dioxide (CO_2**)**

Carbon dioxide (CO_2) is the result of oxygen in the engine combining with the carbon of the gasoline. An acceptable level of CO_2 is between 12% and 15%. A high reading indicates an efficiently operating engine. If the CO_2 level is low, the mixture may be either too rich or too lean.

D. Oxygen (O2)

The next gas is oxygen (O2). There is about 21% oxygen in the atmosphere, and most of this oxygen should be “used up” during the combustion process to oxidize all the hydrogen and

carbon (hydrocarbons) in the gasoline. Levels of O2 should be very low (about 0.5%). High levels of O2, especially at idle, could be due to an exhaust system leak.

E. Oxides of Nitrogen (NOx)

An oxide of nitrogen (NO) is a colorless, tasteless, and odorless gas when it leaves the engine, but as soon as it reaches the atmosphere and mixes with more oxygen, nitrogen oxides (NO2) are formed. NO2 is reddish-brown and has an acid and pungent smell. NO and NO2 are grouped together and referred to as NOx, where X represents any number of oxygen atoms. NOx, the symbol used to represent all oxides of nitrogen, is the fifth gas commonly tested using a five-gas analyzer. The exhaust gas recirculation (EGR) system is the major controlling device limiting the formation of NOx.

F. Particulate Matter (PM): Tiny particles that can penetrate the respiratory system and cause health issues. Diesel engines, in particular, produce significant amounts of PM.

G. 6. Sulfur Dioxide (SO2): Produced from the combustion of fuels containing sulfur, SO2 can contribute to acid rain and respiratory problems.

H. Ammonia (NH3): While not a direct product of combustion, ammonia can be emitted from vehicles equipped with certain types of catalytic converters and can contribute to air quality issues.

3.1.2. Source of vehicle Emissions

The exhaust system collects the exhaust gases from the cylinders of the motor-vehicle engine and conducts them to the rear of the car where they are discharged to the atmosphere, and does so with a minimum of power loss, noise, vibration and transfer of heat to the car body . Also, this heat is later given out to the air which is being inhaled by humans and at the same time the heat is being felt by the human body system. The emissions from an individual car are generally low, relative to the image many people associate with air pollution . The automotive emissions come principally from three automotive sources. They are the fuel

system (evaporative), the exhaust, and crankcase ventilation gases. This showed that there are three different types of automotive vehicle emissions.

A. **The Fuel System (Evaporative)** The fuel system emits the evaporative emissions. Gasoline (i.e petrol), antifreeze, and other auto liquids are made up of hydrocarbons that can be released into the air in many different ways. Diurnal evaporation is a process where gasoline (i.e petrol) evaporates from the engine leading to increase in the temperature outside These emissions are released into the environments which have effect on it. Generally, evaporative emissions are consequence of gasoline (i.e petrol) vapours escaping from the vehicle's fuel system.

B. Exhaust;-The exhaust emissions are the gasses emitted after the engine has burnt the gasoline (i.e petrol) while operating the vehicle [2].

C. Crankcase Ventilation Gases;- As soon as vehicle is filled with fuel, there are emissions that are given off into the atmosphere. If someone can observe closely as he/she fuel his/her vehicle particularly on hot days, emissions can be easily seen as they leave. This is referred to as refueling losses.

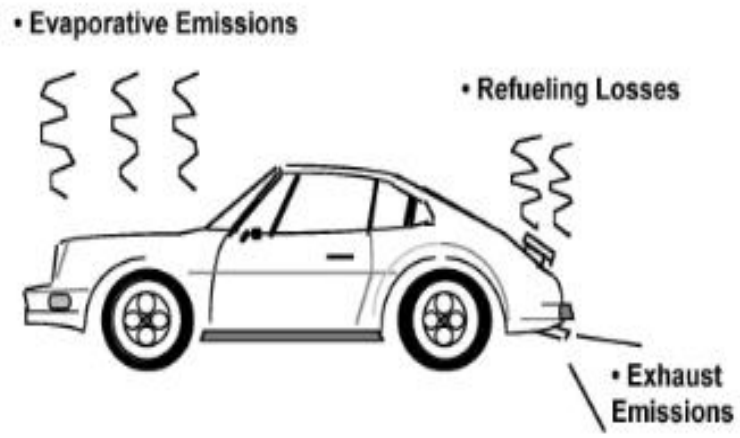

Fig 3.2 source of vehicle emission

3.1.3. vehicle emission control

Controlling vehicle emissions is crucial for improving air quality and mitigating climate change. Here are several strategies that can be employed to reduce emissions from vehicles:

1. Adopting Cleaner Technologies
   - Electric Vehicles (EVs): Promote the use of electric or hybrid vehicles, which produce little to no tailpipe emissions.
   - Alternative Fuels: Encourage the use of biofuels, hydrogen fuel cells, and compressed natural gas (CNG) as cleaner alternatives to gasoline and diesel.
2. . Implementing Stringent Emission Standards
   - Regulations: Governments can establish and enforce stricter emission standards for new vehicles, ensuring that they meet specific limits for pollutants.
   - Regular Inspections: Mandate regular emissions testing for vehicles to ensure compliance with standards.
3. Encouraging Public Transportation
   - Invest in Public Transit: Develop efficient and accessible public transportation systems to reduce the number of individual vehicles on the road.
   - Promote Carpooling: Encourage carpooling and ride-sharing initiatives to decrease the number of cars in use.
4. 4. Improving Fuel Efficiency
   - Incentives for Fuel-Efficient Vehicles: Offer tax credits or rebates for purchasing fuel-efficient or low-emission vehicles.
   - Eco-Driving Programs: Educate drivers on eco-friendly driving habits, such as maintaining steady speeds, reducing idling, and proper vehicle maintenance.
5. Urban Planning and Infrastructure
   - Design Walkable Cities: Create pedestrian-friendly urban environments that reduce the need for short car trips.
   - Bicycle Infrastructure: Invest in bike lanes and facilities to promote cycling as a viable transportation option.

6. Investing in Research and Development

• Innovative Technologies: Support research into new technologies that can reduce vehicle emissions, such as advanced engine designs or improved battery technologies for EVs.

7. Encouraging Vehicle Maintenance

- Regular Maintenance Checks: Promote awareness about the importance of regular vehicle maintenance, which can improve fuel efficiency and reduce emissions.
- By combining these strategies, communities can significantly reduce vehicle emissions, contributing to better air quality and a healthier environment.

3.2. Emission equipment

1.3.1 Emission testers

1. **Exhaust Gas Analyzers;-** Function: Measure concentrations of specific gases in the vehicle's exhaust, including carbon monoxide (CO), carbon dioxide (CO2), nitrogen oxides (NOx), hydrocarbons (HC), and particulate matter (PM).

Types Exhaust Gas Analyzers;-:

- **Infrared Analyzers:** Used for CO, CO2, and HC measurement.
- **Chemiluminescent Analyzers**: Commonly used for NOx measurement.\
- **Laser-based Analyzers:** For real-time measurements and advanced applications.

Fig 3.1 exhaust gas analyzer

2. Opacity Meters

Opacity meters, also known as opaci meters, are instruments that measure the opacity or density of smoke in emissions. They are used to monitor industrial emissions, diagnose diesel engine performance, and ensure compliance with environmental air quality standards. Function: Measure the opacity of diesel exhaust smoke, which indicates particulate matter levels. Use: Often used for heavy-duty diesel vehicles to assess smoke emissions.

Fig 3.2 Opacity Meters

4. **On-Board Diagnostics (OBD) Scanners**;- Function: Connect to a vehicle's OBD system to retrieve diagnostic trouble codes (DTCs) and monitor emissions-related data. Use: Helps identify malfunctions in the vehicle's emission control systems.

Fig 3.2 On-Board Diagnostics (OBD) Scanners

4 Sound level meter

A sound level meter (SLM) is an important tool used in vehicle emission testing, particularly when evaluating noise pollution and compliance with noise regulations Sound level meters play a crucial role in vehicle emission testing by assessing noise pollution associated with vehicle operation. Ensuring that vehicles comply with noise regulations is essential for public health and quality of life, particularly in urban areas. When selecting a sound level meter, it's important to consider accuracy, features, and ease of use to ensure effective measurement and compliance assessment

Fig 3.2 sound level meter

3.3. Testing procedure.

Sample the exhaust at idle and at 2,500 rpm as follows:

1. Using the engine inspection procedure from the beginning of this chapter, be sure that:
    a. The air filter is installed properly and not clogged
    b. The choke is fully open and is not stuck
    c. All vacuum line connections are secure and not leaking
    d. The exhaust system is not leaking and the manifold heat control valve will open correctly
2. Be sure the engine is at normal operating temperature and the analyzer probe is installed properly in the tail pipe.
3. Disconnect the outlet line from the air injection pump or pulse air valve.
4. Check and adjust the ZERO and SPAN setting on the analyzer, if required.
5. Run the engine at normal slow idle and note the HC and CO readings (also CO_2 and O_2 if using a 4 – gas analyzer).
6. Increase engine to a steady 2,500 rpm and again note all meter readings. Return the engine to idle and note any change in meter readings as the engine decelerates. Note the meter readings again as the engine runs at steadily idle speed.

HC and CO emissions should be within legal limits or within the guidelines. Emissions will increase during closed – throttle deceleration, but the readings in step 7 should be as low as, or lower than, the readings in step 5.

3.3. Identify causes of fault

Vehicle emission faults can arise from a variety of issues, often related to the engine, fuel system, exhaust system, or electronic control systems. Addressing vehicle emission faults typically requires diagnosing and repairing the underlying issues. Regular maintenance and timely repairs are crucial for ensuring that vehicles operate efficiently and within emission standards. If you suspect emission faults, it's advisable to have the vehicle inspected by a qualified mechanic who can conduct a thorough diagnosis and recommend necessary repairs.

1.3.1 Causes of vehicle emission

A. Common Causes of High CO Emissions

1. A restricted air filter
2. Restricted air passages in the carburetor or injection system.
3. A rich carburetor or injection fuel adjustment.
4. High float level in the carburetor
5. A stuck or improperly adjusted choke
6. Leaking power valve or accelerator pump in the carburetor.
7. Wrong idle speed
8. Engine oil contaminated by fuel due to excessive blow by or a leaking fuel pump. You can isolate this problem by disconnecting the PCV valve from the crankcase and letting it draw fresh air while monitoring exhaust CO. If CO drops by 0.5 percent or more, the oil is probably contaminated with fuel.

High HC emissions indicate unburned fuel in the exhaust. Incomplete combustion due to a lack of ignition (misfire) or a lean mixture will cause high HC. Although ignition problems often cause high HC, engine mechanical problems and vacuum leaks can also increase HC emissions.

B. Common Causes of High HC Emissions

1. Wrong ignition timing
2. Fouled or worn spark plugs, defective secondary cables, worn breaker points, and other ignition problems that cause a misfire.
3. An overly rich or lean air-fuel ratio.
4. Low compression (incomplete combustion)
5. Vacuum leaks at the carburetor, the manifold, the injection system,
6. Worn valve train parts.
7. Worn cylinders and piston rings

C. Combined High Readings For HC And CO

1. Defective catalytic converter or PCV system.
2. A defective thermostatic air cleaner or restricted air filter.
3. A defective manifold heat control valve

D. Rules of thumb for basic HC and CO testing

- High HC emissions indicate a lean mixture or misfire – unburned fuel
- High CO emissions indicate a rich mixture

E. O2 And CO2 Gas Analysis

Late – model cars with catalytic converters can reduce HC and CO at the tailpipe to levels where they are almost no measurable. CO_2 and O_2, however, can be measured. On a non-catalyst car, high HC indicates unburned gasoline in the exhaust. This is usually due to a lean misfire. On a converter – equipped car, O_2 indicates a lean condition. If O_2 is above 2.0 percent, the air-fuel mixture is probably lean. If O2 is above 4 percent, the mixture is definitely too lean.

At the stoichiometric 14.7:1 air-fuel ratio, HC and CO emissions should be low. Similarly, O_2 should be low, but CO_2 should be high. At lean air fuel ratios, O_2 increases and CO_2 decreases. Also at a 14.7:1 air-fuel ratio, the total percentage of CO and CO2 is about 14.7 percent. Acceptable combustion in a converter – equipped car will produce the following 4 – gas analyzer readings.

- HC and CO – within specification

Self check

Instruction choose the correct answer

1. Which of the following is one of the major exhaust emissions from CI engines compared to SI engines?
   a) Oxides of nitrogen
   b) Particulates
   c) CO and CO_2
   d) Unburnt hydrocarbon
2. Which of the following causes the photochemical smog?
   a) Excess O_2
   b) CO and CO_2
   c) Soot and particulate matter
   d) NO_x and HC
3. What does the blue smoke in diesel engine indicate?
   a) Unburnt oil
   b) HC
   c) NO_x
   d) CO
4. During which condition of the vehicle does NO_x emission in SI engine will be lowest?
   a) Cruising
   b) Idling
   c) Accelerating
   d) Decelerating
6. For what purpose is the Rhodium used?
   a) To reduce CO and HC
   b) To reduce NO_x
   c) To reduce CO
   d) To reduce HC

7. Why is the fumigation technique used?

a) To control HC

b) To control NO_x

c) To control CO

d) To control smoke

8. Why are lead compounds added in petrol?

a) Reduce knocking

b) Reduce HC emission

c) Reduce exhaust temperature

d) Increase power output

9. Which of the following cannot be reduced by thermal converters?

a) CO b) HC c) Soot d) NO_x

10. What can be reduced by using exhaust gas recirculation (EGR) effectively?

a) CO b) NO $_x$ c) HC d) CO and HC

11. Three-way catalytic converters reduce the emission of CO, HC, and soot.

a) True b) False

Operation Sheet 3.1

Operation Title: Petrol Engine Exhaust Gas Analysis

Instruction:

- Keep safe your working area
- Refer to your vehicle's service manual to obtain the manufacturer's specifications

Purpose: To measure the concentration of different exhaust gas

Required Tools and Equipment: Exhaust Gas Analyzer

Precautions: Before making a test make sure engine safe conditions

Quality Criteria: - Measure properly the gases in exhaust gas

Procedures:

1. Compare the gas reading on different rpm with normal engine condition and with fault (Disable the ignition of one cylinder by using test lamp to by-pass the current or adjust the spark plug gap to widen or closed).
2. While performing exhaust gas analysis, monitor the oxygen sensor signal with the use of oscilloscope. Draw the signal of the oxygen sensor on the graph below.

PetrolEmissionTest:GasReading				
Gas	**Reference**	**Actual**		**Remark(Passed/Failed)**
		LowSpeed (IdlingSpeed)	**HighSpeed (2,500rpm)**	
CO	0 -3%			
CO2	12– 15%or higher			
HC	0 -300 ppm			
NO	0 – 800 ppm			
O2	0 – 2%			
Lambda(λ)-1	450mv (14.7:1A/F)			

Note: For lambda place if the air-fuel mixture is normal, lead or rich mixture.

Diagnostic Results:

Carbon MoNOxide_____

Carbon

Dioxide_____

Hydrocarbon_____

Oxygen_____

Reference

1. Akpofure, Rim-Rukeh (2009). *Environmental Science., An Introduction*. Kraft Books Limited. Ibadan, Oyo State.
2. Cunningham, W.P. and (Cunningham, M. A. (2011) *Principles of Environmental Science. Inquiry and Applications*. Sixth Edition.
3. McGraw Hill Publishers. United States.
4. Praveen, K. P., Subha, G. and Rajesh, W. (2017). Environmental
5. Pollution and Safety Measures: International Issues and Its Global Impact in *Global Progress in Development of Sustainable*
6. *Environment*. Discovery Publishing House PVT.Ltd. India.
7. Santosh Kumar Garg (2010). *Ecology and Environmental Studies.*
8. Khanna Publishers. Indian
9. Suresh, K. Dhameja (2013). *Environmental Science.* S.K. Kataria and Sons Publishers. India.

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