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Why should ship building and repair operations implement pollution prevention (P2)?

Shipyards, because of their physical location, wide variety of process equipment and materials, and the outdoor nature of the work conducted at such a large scale, are especially prone to polluting the surrounding air, water and land. Shipyards have a broad range of P2 opportunities to reduce toxic and hazardous exposures and releases to air, land and water, and to save money and improve public image.

Environmental Impacts of Shipbuilding and Repair Operations

A description of the potential health and environmental effects of several key operations and processes in the shipyard industry make a case for investigating and implementing P2 opportunities and best management practices (BMPs):

Abrasive Blasting
This process generates particulate matter, spent slag and abrasives,and heavy metals such as lead, nickel, zinc and copper, from the breakdown of the removed pigmented coatings and substrate. Particulate matter and/or fine dust, causes respiratory and other human health problems if inhaled. The dust can also degrade air and water quality.

Fugitive emissions from blasting operations can travel beyond the blasting area, carried by air or by water. They can migrate to other production areas causing worker exposure, and potential contamination of painting or other operations, contamination to storm drains, other drainage pathways, sediment, and water. Air can carry fugitive blasting emissions outside the shipyard and impact the general public and environment.

Marine Coatings
Conventional primers and paints contain solvents and pigments with heavy metals. Many solvents contain volatile organic compounds (VOC) and/or Hazardous Air Pollutants (HAPs). Over 180 HAPs are regulated under the Clean Air Act. All HAPs and some VOCs are shown to cause cancer, so exposure to workers is a critical issue. Some HAPs and VOCs also contribute to the formation of ground level ozone (smog).

Coating application processes produce overspray, that may become airborne because of the outdoor work and the huge pieces or ship hulls that are coated. Overspray can contain heavy metals, particulate, and volatiles.

Antifoulants
The colonization of barnacles, algae, and other fouling marine organisms onto hulls greatly reduces vessel fuel efficiency and speed. The bottoms of vessels that have prolonged contact with seawater are commonly coated with "antifouling" paints containing biocides that inhibit the attachment of fouling organisms to hulls.

The active biocides have typically been tributyltin (TBT), or cuprous (copper) compounds, such as cuprous oxide, cuprous thiocyanate and metallic copper powder. These coatings introduce contaminants to the water column and bottom sediments through sloughing of paint during use, through discharge of paint chips, and during paint removal and vessel maintenance activities. These contaminants tend to accumulate moreso in water areas with much ship traffic and docking, such as harbours and ports.

TBT causes adverse reproductive and immune effects on shellfish at low levels. If copper accumulates in the aquatic environment, it can have a detrimental effect on marine life. Significant copper accumulation is unlikely to occur in fast flushing open coastal areas, but can accumulate in the sediments of low flushing waters including streams, rivers and bays.

Currently, however, there are few viable alternatives to TBT and copper as the biocide ingredient for marine coatings. (Alternative antifoulant product research is underway).

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Vessel Maintenance
Ship maintenance activities generate waste engine fluids - such as oil, hydraulic fluids, lubricants, and anti-freeze. Fueling activities generate waste liquids and vapor releases to air. Spills and leaks of hydrocarbons, glycols and other pollutants in these liquids can harm aquatic life. Additional waste streams are bilge and ballast waters that contain oil, solvents, and other hazardous constituents.

General Facility and Yard Operations
Solid waste generation, and electricity and water consumption are costly and have their own set of environmental impacts. Unrecoverable solid waste fills landfills and generates leachate. Energy generated via fossil fuels results in greenhouse gas emissions and smog. Excess water consumption reduces water for natural habitat, drinking water, and other important uses. Stormwater must be controlled to prevent contamination of groundwater and surrounding surface waters.

Environmental Regulations and Compliance

This is a list of some of the environmental regulations that may apply to a shipyard's activities:

Air Quality
The Clean Air Act (CAA) regulates air emissions. To control emissions of HAPs, EPA issued National Emission Standards for Hazardous Air Pollutants (NESHAP) which imparts standards that cover emissions limits, work practices, initial performance testing, ongoing compliance monitoring, recordkeeping, and reporting. For the original list of HAPs, go to: http://www.epa.gov/ttn/atw/188polls.html.

Typical shipyard sources of potentially regulated air emissions under the CAA or other local or state regulations, may include:

- Particulate matter [PM] from abrasive blasting
- VOC and/or HAP emissions from marine coating, solvents, solvent-laden paints, adhesives, degreasing and cleaning agents
- Sulfur dioxide (SO2), particulate, VOCs, carbon monoxide, and nitrogen oxides from fossil fuel boilers and furnaces, and from diesel fuel engines in cranes, generator sets, and other equipment and vehicles

Water Quality
The Clean Water Act regulates the contamination of waterways. The National Pollutant Discharge Elimination System (NPDES) regulates discharges from shipyard facilities, which may cover stormwater runoff, wash water, process waters, oily waters (from bilge and ballast water), and releases of TBT, copper and heavy metals from antifoulants and exterior vessel coatings.

There is a federal law banning TBT for all non-aluminum vessels less than 25 meters in length. Under federal law, TBT may still be used on larger civilian vessels and on aluminum boats. U.S. law does not apply to vessels that are coated overseas and call on U.S. ship repair facilities for hull maintenance activities. A global convention was proposed to be in effect January 1, 2003, banning application or re-application of TBT altogether, worldwide. However, the International Maritime Organization (IMO) says that as of March 31, 2004, only eight Governments (representing 9.36% of the world tonnage) have ratified this Convention. For the Convention to enter into force, it is necessary that 25 States, the combined merchant fleets of which constitute not less than 25% of the world's merchant shipping.

Hazardous/Solid Waste
Shipyards are subject to regulations under the Resource Conservation and Recovery Act (RCRA) regarding the treatment, storage and disposal of hazardous wastes and solid wastes. RCRA wastes include sludges and still bottoms containing heavy metals or other hazardous compounds, spent solvents, oil and oily water, spent abrasives containing heavy metals and paint residuals, reactives, solvent-bearing paint wastes, solvent-laden rags, and more. RCRA also promotes metals recovery from wastewater treatment sludge and requires regulatory impact analysis for 180-day accumulation wastewater treatment sludges.

Oil Spills
The Oil Pollution Act mandates an array of operational requirements intended to prevent spills, most notably the replacement of single hull tankers and barges with double hull vessels. The law requires certificates of financial responsibility evidencing coverage to the new limits.

Occupational Safety and Health
The Occupational Safety and Health Administration (OSHA) and National Institute for Occupational Safety and Health (NIOSH) set occupational safety and health guidelines for chemical hazards and summarizes information on permissible exposure limits (PEL), chemical and physical properties, and health hazards. Blasting abrasive residuals and dust, as well as most of the aforementioned hazardous substances and wastes fall under OSHA and NIOSH (and potentially additional state) guidelines.

Cost Savings and Avoidance

Often, businesses only account for waste disposal costs rather than considering all of the associated costs of using toxic raw materials and polluting, energy or water-consuming processes, and inefficient technologies. Total cost accounting ensures that certain management, engineering, and overhead costs are tagged to cost considerations for environmental operations. Consider all potential cost and savings opportunities associated with improving environmental performance:

Raw Materials Reduction in Quantity or Toxicity
Storage and inventory
Spill prevention
Secondary containment
Container labels

Water Use Reduction
Water use
Sewer and discharge fees
Wastewater treatment
Sludge handling and disposal

Solid and Hazardous Waste Reduction
Waste collection and containers
Labelling
Onsite management
Recycling and reuse opportunities (and avoided purchase of new or virgin materials)
Disposal and transport

Air Pollution Reduction
Inspection and monitoring
Ventilation
Pollution control equipment
Permit and discharge fees

Management and Overhead Costs to Consider
Permit preparation and maintenance
Regulatory impact analysis
Hazard analysis and communication
Product/vendor research
Emergency planning, spill response procedures and equipment
Right-to-know, emergency, and other safety and health training for staff
Inspections and audits
Information and tracking systems
Regulatory reporting
Legal fees

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Penalties and fines for non-compliance
Insurance, including liability

Public Relations and Marketing

Employing the best environmental practices and products is important for maintaining a good image with the public and stakeholders, as well as keeping customers and maintaining competitiveness.

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PPRC is a member of the Pollution Prevention Resource Exchange, a national network of regional information centers: NEWMOA (Northeast), WRRC (Southeast), GLRPPR (Great Lakes), ZeroWasteNet (Southwest), P2RIC (Plains), Peaks to Prairies (Mountain), WRPPN (Pacific Southwest), PPRC (Northwest).