OBSERVATIONS AND RECOMMENDATIONS FOR THE PREVENTION OF OIL POLLUTION

WORKING PAPER NO. 81

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June 1970

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June 25, 1970

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INTRODUCTION

Background

The prevention of oil spills and the control of oily discharges are of great importance to the oil industry and regulatory agencies. Control measures are an absolute necessity, not only because of the adverse effect spilled oil has upon the aquatic environment, but also because of the values the refined products represent. In addition, to fuel and lubricating products, many valuable by-products are recovered and/or manufactured from the world's crude oil. These by-products include waxes and paraffins which are increasing in value.

Raw crude oil is a very complex, heterogeneous mixture of many forms of carbonaceous materials. Crudes such as Sumatran or Persian Gulf are very viscous because of the tar and asphalt content. These crudes must be kept heated in order to be handled. Alaskan crude has a very low tar and asphalt content and can be handled easily at 50°F. The wax and paraffin contents of Alaskan crude are relatively high, being less dense than sea water and float on the water surface. The tars and heavy asphalts in crude oil, being more dense (specific gravity 1.2) than sea water, will sink as they separate from the waxes and paraffins and the volatile fractions evaporate.

Problem

Presently the methods, procedures, and techniques employed by the oil industry for the handling and marine transporting of crude oil are largely unknown outside of the industry. These must be fully understood by the regulatory agencies in order to assist the oil companies in the control and prevention of oil pollution.

Authority

At the request of the Commissioner, Federal Water Quality Administration (FWQA), arrangements were made through Hendy International Company for a representative of FWQA to board the SS ATLANTIC ENGINEER and observe crude oil handling techniques and ship operations at sea. The FWQA observer boarded the ship when it docked at Terminal Island, California, on April 29, 1970, and remained aboard until it arrived at Homer, Alaska, on May 6, 1970.

Objective

The objective of this trip was to answer the following questions regarding marine transportation of crude oil with particular emphasis on potential or observed oil pollution problems.

1. What are normal ship operations procedures relative to scheduling, crew changes, etc?
2. What are the procedures used for handling crude oil?
3. What ballasting procedures are used?
4. What procedures are used during tank cleaning operations?

5. What new or improved techniques, methods, procedures, or processes must be employed or included to prevent oil pollution?

Acknowledgment

The friendly cooperation and assistance of Atlantic Richfield Company and Hendy International Company is gratefully acknowledged.

APPROACH

Answers to the above questions were obtained from visual observations of cargo handling procedures, ship operations, conversations with key crew members, and discreet analysis of pertinent oil or water samples.

The above findings are presented and discussed below in four major categories. These are:

1. General ship operations, ship operating procedures, schedules, sailing routes, and manning procedures;
2. Cargo handling procedures;
3. Ballasting practices and procedures;
4. Tank cleaning procedures.

General Ship Operations

Schedules and Operations

In general, the industry considers crude oil carriers as tankers and refined product carriers as chemical ships even though the overall design is the same. Many tankers under U. S. registry are managed, scheduled, and operated for the owners by a consulting firm; for example, Hendy International Company performs these services for Atlantic Richfield Company. Turn-around time is minimal because the derived profits are based upon the amount of cargo delivered in the shortest possible period of time. In general, the places for loading and off-loading cargo are known and scheduled well in advance, and are based upon the normal cruising speed of the individual vessel, the ship's capacity, and the capability of the shore facilities.

Routes

Most West Coast tanker traffic between California and Pacific Northwest ports is seldom farther than 10 to 12 miles offshore. Prevailing westerly winds will soon move any discharged floating materials upon the beach without too much dispersion. Floating materials discharged at least 50 miles offshore will take a longer period of time--if at all--to reach the West Coast--and will be much more dispersed by the time they reach the coast.

Most West Coast-Alaska traffic is found in one of three well-defined sea lanes. These sea lanes are shown in Figure 1. It can be noted from Figure 1 that all ships including those going to and coming from Alaskan Ports are relatively close in shore between any California port and Cape Blanco. No deballasting or bilge discharging should be permitted in the above area because of the close proximity to shore and resultant hazard to sea birds and other forms of aquatic life.

On the San Pedro (Terminal Island) to Nikiski, Alaska, run typical daily noon positions follow:

First day out, 40 miles west of Monterey, California course 321°T

Second day out, 150 miles west of Crescent City, California

Third day out, 510 miles west of Grays Harbor, Washington

Fourth day out, 141°W 52°N

Fifth day out, 146° 10'W 56° 20'N

Sixth day out, Mikiski or Drift River, Alaska

Manning

The crew signs on for three-month periods. The officers are salaried, but the remaining portion of the crew is paid on an hourly basis for actual time of work. Relief crews are used to operate the ship in the most frequent ports-of-call on the West Coast thus, the crew which actually rigs the gear, and connects and disconnects the hoses may be unfamiliar with each ship's peculiarities or exact *modus operendi*. This creates and increases the possibility of oil spills from the hoses or faulty connections. No orientation regarding their duties is given and their assigned tasks are accomplished by trial and error.

Cargo Handling Procedures

Tanks and Pipery

The tanks are numbered from forward to aft and are designated as port or starboard wing, or center. The wing tanks are usually less than half the size of the center tank in a row. As example, on the *SS ATLANTIC ENGINEER* the capacity of each wing tank is about 5,000 barrels, and the capacity of each center tank is about 13,000 barrels. In most tankers the outside and the bottom of the tanks are the hull of the ship. A hole in this part of the ship is automatically a hole in a tank. A hull rupture allows the tanks' contents to escape to open water.

The main cargo pipeline has a diameter of 20 inches. This line feeds three 16-inch pipelines each one of which runs fore and aft through a row of tanks. The tanks' 16-inch main line is twelve feet off the bottom and is fed by a 10-inch pipe (called a stringer) that extends downward for 8-feet. The open end of the stringer is four feet off the bottom. Thus, the material remaining in the bottom of the tank is four feet deep and cannot be removed by conventional means. Some tankers are equipped with smaller diameter pipe line which are installed on the bottom of the tanks. This facility is used to strip the remaining material (sludge) from the tank. It may then be transferred and stored in one of the after cargo tanks which are designated for sludge storage purposes.

Cargo Discharge Practices

The gear and hoses are rigged and connected by the deck force under the direct supervision of the boatswain. The cargo is handled by the pumpman who also assists the desk force in connecting the hoses to the ship's cargo pipe line. Both of these operations are under the overall supervision of the mate on duty who may not be sufficiently familiar with the finite operations of the ship or aware of his responsibility to prevent oil spills.

On the Atlantic Engineer the ship's boom is used to lift the two 12-inch diameter rubber hoses aboard and to connect them to the 20-inch diameter cargo pipeline by a flanged "Y" fitting. After the connections are inspected by the mate, the pumpman is ordered to commence discharging cargo from the most forward set of tanks. At times, drips and leaks at these connections and during hook-up and disconnecting operations are ignored allowing the oil to accumulate on deck or possibly to spill over the side if the situation is not corrected. Cargo discharge can proceed without interruption. As one tank is emptied the valves to the next one are opened and discharge continues. In general when taking on cargo the tanks are filled from aft-forward.

Entries regarding the handling of crude oil are made in the ship's smooth log as well as in the oil log. The completeness of these entries is extremely variable between different ships as well as different masters and mates. As example, the logs on one ship may contain information relative to when the hoses were connected, when cargo discharge was commenced, the pumping rate, if there were any leaks or similar problems, when cargo discharge was completed, when the hoses were placed ashore, and the names of the mates on duty at the time of the entry. On the other hand, these could be a single entry by date - noting that cargo was being discharged and the entry could be signed by the chief mate and an oil company employee. The oil company employee signs for the company showing the ship discharged and the shore side facilities received a noted volume of crude oil.

Ballasting Procedures

General Practices

Ballast water is taken aboard by the use of the cargo pumps (induction system) and put in preselected tanks under the supervision of the chief mate, upon orders of the master. There are three different layers of material in a dirty ballasted tank. The top layer - "slop" - contains the remaining light fuels, oils, greases, waxes and paraffins. Analysis of a slop sample from No. 4 port tank revealed a total oil concentration of 10,200 ppm. The middle layer is sea water and dissolved and emulsified oils. The ballast water held in No. 4 port tank had a total oil concentration of 2,800 ppm. The bottom layer - sludge - contains tars, asphalts, sand, and rust.

Not all of a ship's tanks are used for ballasting, but all of the tanks that are used are filled completely. Sea water and sludge are in the bottom 4 feet of the tank after ballasting.

Each master has his personal tank combination for ballasting under normal conditions at sea, and his own method of operating the ship under various conditions of sea and weather. Thus, when a tanker is in heavy weather the master can slow down and/or take on more ballast by filling additional tanks. When the weather has moderated the master can increase his speed and/or discharge the additional ballast. When this is done, most of the sea water ballast and slop are discharged over the side from ships that do not have stripping lines and store the slops in designated tanks.

These slops float on the water surface in the tank and are discharged in a slug.

Slop, sea water, and dissolved and emulsified oils are discharged over the side by either gravity and/or pump when deballasting and without exercising due regard or caution. The slops which float on the water create a hazard to waterfowl and other forms of water-oriented wildlife. The dissolved and emulsified oils are also a hazard to fish, plankton, and other forms of aquatic life. In order to prevent damage to aquatic-oriented organisms, the slops and ballast waters should be discharged to shore holding and treatment facilities.

The State of Alaska Water Quality Standards regarding the discharge of oily material allows no visible film or slick created by the effluent (discharged wastes). The State of Washington Water Quality Standards allow the discharge of an oily effluent with less than 10 ppm total oils.

The ballast water on the SS ATLANTIC ENGINEER would have had to be diluted 280:1 before it would meet the State of Washington minimum water quality effluent standards.

The general attitude (lack of due regard) on the part of the pumpman is another reason oily wastes are discharged near shore or in confined waters. Dirty ballast water could be discharged at sea but unless the pumpman was careful during ballast discharge he could also allow the slops to be discharged. The master may be on a new route in unfamiliar waters and not familiar with the laws concerning the discharge of oily wastes. These oily wastes are just as damaging to the aquatic environment as the materials which are accidently spilled.

It is reported most shore installations do not have facilities to handle ballast. Shore installations that do have ballast and slop storage and treatment facilities usually do not have adequate capacity to properly store and treat these wastes. Because of this, most tanker captains are forced to discharge their ballast and slop at sea. Adequate receiving, storage, and treatment facilities must be provided to eliminate the necessity of discharging dirty ballast to open or confined waters.

Tank Cleaning Procedures

Stripping

The two main oil loading facilities in Cook Inlet are at Drift River and Nikiski, Alaska. The quality of the crude oil at these two depots is very similar except for the amount of contained sand. As has been mentioned above many tankers, such as the SS ATLANTIC ENGINEER, do not have stripping lines in the bottom of the tanks; thus, their tanks cannot be emptied completely. Cargo tanks on the SS ATLANTIC ENGINEER are cleaned every third trip from Drift River and every other trip from Nikiski to remove the sand and sludge residues. On tankers with stripping lines the sand and sludge residues are transformed to certain designated tanks, stored, and discharged ashore for processing. The cargo tanks on these ships require much less frequent cleaning.

Butterworthing

A unique double-nozzled hydraulic appliance called a "Butterworth" is used to clean tanks. The angle of the movable nozzles on this apparatus are balanced and opposite which allows each nozzle to move through the full 180 degrees of a hemisphere. The ships fire pumps are used to supply the required amount of sea water at 165 pounds per square inch pressure used for washing the tanks. Butterworthing takes about four hours at sea and 8 hours at the dock. One reason for this difference in cleaning time is the amount of dilution water available and the size of the dispersion zone. Another possible explanation is that in port because of the fire hazard port authorities and shipyards require extra clean tanks to prevent accidents.

The tanks are normally washed at four levels from the top down. About one-half hour is spent washing the top level and about one and one-half hours are spent washing the lowest level. The flow of water through the Butterworth is about 500 gallons per minute. Occasionally some additives are used but their amounts are reported to be minor. The sludges are much more viscous than the slops and require more water and time for them to be scoured from the tank bottom.

The Butterworthed washings are sucked from the tank and discharged over the side by the cargo pump (main induction system), which has a flow of about 6,000 gal. per 1 min. The diluted continually discharged tank residues probably cause a sheen, or film but this should not be a hazard if done in the above manner and in the open ocean. A definite hazard to seabirds and other aquatic life would be created if the Butterworth wastes were discharged in intermittant slugs. This is entirely possible since the flow ration between the main induction line and the Butterworth unit is 12:1.

After the tank has been cleaned completely on the SS ATLANTIC ENGINEER a four foot deep pad of sea water remains in the bottom of the tank. This remaining sea water (occupying about 7 percent of the tank volume) is mixed with crude oil when the cargo is taken aboard. Some of this sea water will mix with the lighter fractions of the crude but the heavier crude oil fractions and sand will sink to the bottom of the tank.

Normally, tanker crews on the Alaska run start to clean the tanks the second day out of port if the ship is beyond the 50-mile limit or continental shelf. "Coasters" that clean their tanks at sea and do not get that far offshore probably start cleaning their tanks as soon as they reach the open ocean. Many near-shore oil spills are probably created by this method of ship operation. The only way oil pollution can be prevented in coastal waters is for all ballast, slops, tank cleanings, and bilge materials to be discharged to adequate shore facilities.

In conclusion oil pollution can be controlled and/or prevented. The causes and sources of oil pollution are poor and/or inadequate gear and equipment and/or carelessness during certain ship's operation.

RECOMMENDATIONS

The following specific recommendations regarding procedures, techniques, and equipment should be implemented to prevent and control oil pollution from marine sources.

Equipment

1. Develop gear and equipment specifically to be used for handling cargo hoses. This could be in the form of cradles, straps, slings, etc. with a fish davit in place or special booms used to bring the hoses aboard.

2. Install "quick shut-off" valves on the ship end of the cargo hoses.

3. Install a tank stripping system in the bottom of the tanks.

4. Construct new or increase the size of existing shoreside facilities at all on and off loading facilities for storing, handling, and treating all slops, sludge, bilge, and ballast wastes.

5. Install oil collecting pans (trays) and traps under each hose connection.

6. Design and install a device in the cargo tank which will keep the oil and ballast water completely separate.

Operating Procedures

1. Use some of the cargo tanks for storing slops and sludge.

2. Butterworth effluent should be discharged only to the open

ocean beyond the Continental Shelf, or in port to a shore treatment facility.

3. Require the oil and ship's logs to be kept and maintained in a more detailed manner. All ship operations including slop handling, ballasting, and tank cleaning should be entered in detail. This includes which tanks were used for ballast purposes, the fore and aft drafts of the ship, how the ballast was discharged, length of time this operation took place, and the location of the ship when this was being done. Each major entry should be initialed by the mate on watch.

4. Use certain tanks for ballasting only and provide sensor controls with warning system which would warn the mate and pumpman of slop in the line, shut off the individual tank valve, and stop the over the side discharge of slop.

Other

1. Use loss of pay as incentive to create a more careful working attitude among the crew.

2. In addition to the master, the firm in charge of operations should be financially responsible for oil pollution.

3. Conduct a vigorous public relations campaign directed at informing the crew and the operators of shoreside facilities that oil spills can be prevented.

4. Vigorously enforces the public laws and company policies for the prevention of oil drips, oil leaks, and oil pollution from

spills.

5. Distribute a digest of the present and future oil pollution prevention laws and regulations through "Notice to Mariners".

6. Help prevent ship collisions at sea by designating discreet portion of the sea lanes for one directional traffic. "Near misses" or instances of disregard for the observance of the Rules of the Road should be reported to the appropriate authority.

SUMMARY

Oil pollution can be prevented or controlled by the following means:

1. Require and provide the necessary equipment.

2. Require better oil handling techniques.

3. Require adequate handling, storing, and treatment facilities ashore.

4. Require that all oily material be discharged to shore facilities.

5. Extend the area of responsibility to include more individuals.

6. Tighten the regulations governing all oil spills.