Critical factors of fuel distribution process in Brazil and its relevance to environmental management

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Abstract
This article aims at analyzing the process of physical distribution in secondary bases in Santa Catarina (Brazil), under the focus of environmental management, with the drivers that make fuels transportation. Through a survey of one in 2011, with backing from the literature review, a survey was conducted with 201 drivers that are loading the bases Secondary Santa Catarina. Concluded that there is contamination due to handling, transport and discharge of fuel, varying the contamination level in each phase.

Keywords: loading, transport, unloading, fuel, handling, contamination and drivers.

Introduction
Jollands, Lermit and Patterson (2004) and Becken (2007) point out that the logistics process should be a prerequisite for sustainable development and economic development. The transportation fuels in Brazil follows the model of vertically integrated chain for fuel distribution and few agencies provide statistics on transport and contamination caused by fuel that can be deployed the following organs: CETESB, IBAMA, ANTT and ANP. Therefore this paper tries to answer: What are the environmental impacts on physical distribution of fuel between the bases and secondary customers? This article attempts to identify whether there is contamination of fuel, due to the loading, transportation and unloading, which occurs most frequently.

The present study was designed in six sections where section 2 presents the literature review; section 3 details the location studied, section 4 presents the research methodology, section 5 describes the results and section 6 contains the conclusion , closing the work with appropriate references.

The transport of fuel
To Hartman (2010), transport fuels made by highways presents a major risk of accidents and contamination to the environment. For Gheorghe (2006), even with the strict legislation for the transport of dangerous goods and the laws that protect the environment, accidents are still

occurring. To Leal Jr (2006), the occurrence of accidents involving dangerous products show the need for the involvement of businesses and government agencies in order to prevent possible accidents, the author highlights the commitment of companies in the transportation of dangerous goods, as 59.58% of its fleet are less than five years, the opposite of cargo sector, where 1.2 million vehicles have over eleven years of manufacturing.

The transportation fuels, according to Leal Jr (2006), undergoes continuous monitoring, but despite the commitment of companies, approximately 40% of vehicles have over five years of use. Companies must fit the vision of environmental management, Cardoso (2004), Ballardin (2007) and Souza (2009) describe that certifications such as ISO 14000, are preventive practices in strategic vision, and the way to environmental management. To Leal Jr (2006), the lack of certifications and clarifications on accidents in the petrochemical chain causes a false impression, not giving accidents and environmental impacts due importance.

Lieggio Junior (2008) and Transpetro (2010) point out that the transport of production of petrochemicals from oil refineries is done mainly by road transport, with this scenario, accidents and environmental disasters on highways are on top of the statistics. The state of São Paulo is the one with the highest rate of environmental claims, in 2007, 53.7% of the occurrences happened because of road transportation (CETESB, 2009).

Describes Yang and Chen (2005) that, due to technological advances in the production of petrochemical industry in the nineteenth century environmental risks have increased. With the new variables fuels such as fluidity, volatility and flammability, consequently, the risks increase with the possibility of infiltration into the soil and groundwater contamination, causing disasters and accidents over the years.

Performance assessment and transport to avoid environmental impacts

Companies are controlling and evaluating their performance with stake in environmental performance reviews; to achieve the objectives of stakeholders, companies should adopt preventive maintenance and minimize the need for corrective (SOUZA, 2004 and MALIGO, 2005). According to Vincent (2005), companies are developing ways to monitor and evaluate their own performance. Have to Barros (2006), Leal Jr. (2006) and Ballardin (2007), the performance evaluation can become complex if poorly organized or conducted, leading to results that do not reach the expected process, for example, the sector transport and handling of goods transported. Aiming at improving the performance and meet demand, it is possible to make use of more than one mode for transportation, or multimodal (PAIN et al. 2,007; LIEGGIO JR, and CETESB 2008, 2010).

In this research can be noted that the use intermodal is determinant to achieve the desired performance, and all modes are used to transport oil and its derivatives, however limited research bases secondary to delivery to the consumer. The choice of mode interferes heavily in the performance of the market and evaluation of transport should be done periodically to prevent accidents and contamination and also improve the distribution medium (Vasconcelos, 2007).

Perez (2007), Rivadeneira (2007) highlight the need for performance evaluation and analysis. In the studies cited, the authors emphasize with regard to performance in transport for the following items: understanding of the processes, its complexity, practices adopted by other organizations, performance evaluation, definition of focus, scope and supply chain level analysis.

Models of Distribution of Oil and its derivatives

According Shobrys and White (2000) and Ribas (2008), the oil industry, uses the integrated model for distribution of oil and its derivatives. To Ribas (2008) throughout its structure is involved in the process: exploration, refining, marketing and distribution of products, each step tends to influence the outcome of the other.

The oil exploration is the beginning of the chain, after extraction, the product is transported by tankers to terminals (ports), which is connected ships to pipelines that carry oil to the refineries bases (primary), making it necessary to incorporate the modal plan for transportation and supply chain. Then, the processing of crude allows conversion into oil products, which depends on other process to obtain the best use of the system in each refinery (RIBAS, 2008). Describes Leal Jr (2010) that oil and its derivatives are transported by pipelines to distribution centers (secondary bases) that are responsible for making the distribution. After this step, the distribution is done by various modes such as: pipeline road, road, rail and water transport (common in northern Brazil) to the point of consumption.

To Lababidi (2004) to the integrated oil has many uncertainties that cause significant impacts in its planning. So Shobrys and White (2000), emphasize that the planning models are classified into three groups: strategic, tactical and operational.

- Strategic: refers to long-term planning, ie, faces the location of extraction and production of oil, this planning varies from five to fifteen years.
- Tactical: focus on the medium term, performs the tasks and set operational performance targets, and coordinate sales activities, materials management, production and distribution (SHOBRYS and WHITE, 2000).
- Operating: this focus on short-term decisions, such as quality of products produced at a refinery to be refined and the volume (SHOBRYS and WHITE, 2000).

For a better understanding of the model used in the oil industry in Brazil, will be addressed segments of the industry, which is divided into three phases (Ribas, 2008).

- Upstream: is the activity of exploring, drilling and transporting crude oil to the refineries.
- Midstream: is the stage where crude oil is processed and refined various products that will be marketed.
- Downstream: is directly connected to the logistics process between the refineries and consumers. This phase is done pumping the refineries, storage bases in secondary loading in CT and delivery by the consumption points.

This research focuses on the downstream phase, but the process will be addressed after loading the secondary bases.

Visualize yourself also, refineries, natural gas units, terminals and pipelines; chain has Brazilian integrated oil mills producing vegetable oil fields exploration and distribution bases or secondary bases, where is the received fuel to be sent to points of consumption (industry, transport, power plants, steel mills, among others) (Ribas, 2008).

Basis of charging and its operation

This article is based on two pillars, which are the physical distribution of fuels and environmental management applied bases searched. The evaluation of the first is necessary to identify the effectiveness of environmental management.

The distribution bases

Bases fuel distribution is equivalent to a distribution center for consumer goods - CD and can receive fuel and vegetable oils, always aiming to minimize costs. To Neiro and Pinto (2005) and Ribas (2008), each base is suitable as your demand and aims to bridge the gap between specific production and consumption centers, consignment procedures. The foundations of Santa Catarina (Santa Catarina Pipeline Paraná - OPASC) are located in the cities of Guaramirim (Base de Joinville - BAJÓI), Itajai (Base Itajai - BAJAÍ), Biguacu (Base Florianópolis - Baflo) and receive fuel through ducts of the Presidente Getúlio Vargas Refinery - REPAR, storage tanks is done in air. The bases have the following storage capacities: Base de Joinville - BAJÓI: 25,000 m³, Base Itajai - BAJAÍ: 43,000 m³, Base Florianópolis - Baflo: 34,000 m³ (PETROBRAS, 2011).

The bases are equipped with containment area, sorting boxes, containment basins and fire system. The supervision and inspection are done by various environmental agencies, the Fire Brigade, the Brazilian Association of Technical Standards - ABNT and ANP (MALIGO, 2005).

The secondary basis

The secondary bases of fuels receive primary bases (refineries) through transfer, which can be done by railroads, waterways, rail or pipeline (SINDICOM, 2011). The secondary bases are intended to store and distribute fuel to distributors and consumers (MALIGO, 2005). The shipping to distributors and consumers in Santa Catarina is done by road, such transfers (Ribas, 2008). Figure 4 shows the fuel distribution chain. The research focuses on the secondary bases, where they are received and loaded in the fuel Tank Truck - CT.

Distribution centers are located in strategic locations in order to facilitate and expedite transport. For the distribution of fuels in Brazil, the mode used at each base takes into account the location and available infrastructure (Cardoso, 2004; SOUZA, 2004 and Barros, 2006). Maligo (2005) highlights that the foundations are built to receive more than one way through this contingency and flexibility in the operation applies to the consignment.

The bases studied receive fuel Araucaria - PR (REPAR) via pipeline and these are distributed through the railroads, trucks in various capacities, ranging from 10m ³ to 50m ³ (PETROBRAS, 2011).

The truck drivers

Truck drivers are responsible for transporting fuel by road transport between bases, dealers (distributor, reseller and retailer carrier - TRR and gas stations) and the consumer (industry and agriculture) (Cardoso, 2004; CETESB, JR 2004a and LIEGGIO , 2008). Maligo (2005) describes that the loading on the basis of fuels is achieved by the drivers and operators. According Ballardin (2007), drivers receive specific training on each base to become able to perform the loading, the trainings have, on average, two hours and the first shipments are accompanied by other more experienced driver. According to Petrobras (2011), the training they receive retraining after a certain period, on average two years in order to minimize the risk of accidents and contamination.

For Santos (2006), drivers and operators are exposed to the risks of the work environment, however, the professionals who have less knowledge about the work environment are prone to cause accidents and contamination. According Dores et al., (2007), 80% of drivers who transport hazardous products have school. According to these authors, low education hinders assimilation Course Handling of Dangerous Goods - MOPP. It also emphasizes that many drivers do not understand the labels of security panels, which serve to identify the product

and its degree of risk. Another fact raised is the difficulty of access to the Personal Protective Equipment - PPE and Collective Protection Equipment - EPC if they have to be used in an emergency quick action.

For agencies like ANP and ANTT, safety equipment should be in a visible location and easy access to that besides the drivers, other people have access, whether on the roads or transport in the discharge. In search of Santos (2006) another factor that draws attention is the fact that 1.8% of drivers do not have course of MOPP and 2.5% did not answer the question, and the course of MOPP is mandatory requirement to carry dangerous products.

For Larsen (2004), accidents caused by drivers after loading the bases, ie, the transport to the customer, occur due to vehicle situation and interaction with the environment. In his research, in Denmark the risk of truck accidents is six times higher than passenger car and observed major factor in the cause of accidents is speeding, a fact confirmed by the drivers in the study. Hartman (2010) highlights the driver's age as a relevant factor and cause of accidents in transportation fuels. The age group that has the highest accident rate is 18 to 29 years with a percentage of 49.25% and the lowest is 40 to 49 with 10.20%, the survey was carried into St. Paul and did not consider the route traveled.

In the event of an environmental accident on the route between the station and the distributor, the distributor, carrier or post must be supportive, according to the Federal Law No. 6.938/81. For Barros (2006), the case in solidarity in the accident does not have insurance, the disorders can take large proportions due to environmental liabilities. For Ferreira (2003) work overload and stress of motorists are other factors that increase risk, whereas in their study, 48.7% of road transport undertakings dangerous products monitor these two factors. For this author, beyond the control of transport, another factor to be monitored is the discharge from dealers and consumers.

According to the study CETESB (2004 and 2010), are frequent in the delivery of fuel spills, when connecting and disconnecting the hoses in the mouths of discharges and handling hoses, buckets, gloves, or any equipment that has contact with the fuel on discharge. According to Silva 2004, Leal Jr (2006), molding (2006) and Ballardin (2007), the leaks occur during the unloading operation and close the fuel discharge nozzles, tank overflow caused by the spill or product still present in discharge piping of the tanker at the end of the operation.

Transport

The transport of fuel stations and bases for final consumers is done by road, via tanker trucks CT, and the transport capacity of CT varies, being generally between 10m ^{3} to 50m ^{3}. For the population, the gas stations are the most visible in the fuel distribution chain (MALIGO, 2005). According to Schroeder and Castro (2002), road transport is a key to the intermodal transportation of petroleum and its derivatives since the 50s. In 2008, Brazil had 165 road haulage companies registered in ANTT, and of these, 85 working in the transportation of dangerous goods.

The transportation fuel via road transportation is the most used because of its scope, reaching the most remote locations. Although this type of transport (road) absorbs a large share of the costs, logistics is key when it comes to dangerous products. So, to make transport fuels are necessary qualified and trained professionals, able to identify the products and documentation required (BALLARDIN, 2007).

The transport between the bases and the customer by road may cause negative impacts on the environment through the emission of air pollutants and risk. In case of accidents, the

environmental impact can be short, medium or long term, which can compromise more or less future generations, due to contamination of fauna and flora, soil, groundwater, rivers, oceans and life on the planet (GUSMÃO, 2002; RODRIGUES, 2007 and MAIA, 2008).

According to Leal Jr (2006), factors such as poor road conditions, weather, cargo theft and lack of knowledge about the risks they represent the dangerous cargoes, both for drivers and for other vehicles that travel on roads, to serve increasing the number of accidents. Another reason stated is the lack of knowledge on the part of road users on the nameplates that serve to differentiate products transported by trucks and guide as to the degree of risk.

Methodology

Research is divided into two phases, we used the following research methods: as the first phase we conducted a qualitative exploratory research, based on the analysis of secondary data. The second phase of the research was to analyze the level of training of drivers to identify those causing environmental impacts and their ratio. It used a Likert scale ranging from 1 to 6 being greater than the degree of relevance is 6. In order to increase the freedom of expression of officials with regard to what actually think about the processes used to mitigate environmental impacts by the bases and fuel distributors and their involvement impacts, questionnaires were given to the respondents and the return was made in an urn, and was guaranteed the anonymity of the interviewee.

Discussion of Results

We analyzed the three levels of performance drivers, bases loaded, trucking, fuel delivery, and the level of training to avoid accidents and contamination.

The level of training for unloading the fuel has the highest percentage being between medium and high, confirming the research Simões (2002) to highlight is that the discharge occurs where small contaminations and are major sources of environmental impacts, by reason of no control and monitoring of these contaminants and the fact that directly reach the environment.

Table 1 – Influence of contamination and acidentes in each place

Place of highest rate of contamination	Average
Nautical Supply (boats, marinas etc.).	2,81
Earthmoving Companies	2,76
Builders	2,67
Agriculture (farmers, cooperatives, etc.)	2,51
Gas stations	2,48
Condominiuns, resorts e shoppings	2,46
Industry	2,42
Transportation companies	2,40
Transport to the customer	2,28
Charging base	2,06

Table 1 shows the results obtained in the main fuel delivery sites, using a scale from 1 to 6 the average range from (2.06) to (2.81), and the supply nautical, which is made in marinas piers for anglers and even directly on the boats, ships, tugs, among others, has average (2.81), this result is troubling, mainly because that will happen if a contamination, the impact will be of great proportion therefore directly reach the waters and spread quickly.

With the data obtained, it is clear that contamination occurs as the result of research more worrisome, since several contaminations occur in places that do not have adequate infrastructure to contain the leak and may be cited nautical supplies, earthmoving and agriculture, and bases and stations there is a containment area to address possible spills or leaks. This survey confirms the research Ribeiro and Lisbon (2000) by claiming that contamination often occur.

The following is presented a review of the procedures for loading the bases, where it was asked if the base declares all contaminations to verify and compare with if indeed practices are confirmed, since the base has certifications with ISO system and Environmental Management - EMS. This question was based on studies Ballardin (2007) who researched the terminal Petrobras Distribuidora the city of Canoas, the metropolitan area of Porto Alegre, state of Rio Grande do Sul is denominated TENOAS, abbreviation to identify the base that is most of southern Brazil. Petrobras administers the secondary bases of Santa Catarina, the research focus.

Considering the scale of 1 to 6 shows the stress as the main cause of accidents and contamination with (3.82); traffic is second (3.79) and workload with (3.78) in the influence and proportion; may conclude that traffic and workload are the main reasons of stress in transport fuels, confirming studies Lieggio Junior (2008) and Hartman (2009), according to which these factors have great influence in accidents. Excessive speed with average (3.63) ratio, as contamination factor, and 9% of drivers confirmed exceed the speed limit. Roads and trucks tanks - CTs that are directly related to the conditions and maintenance of them appear below. Time is influenced by experience (3.39) and the drivers are then justifying that experience is the determining factor for the improvement of drivers, confirming the research (HARTMAN, 2009 and 2010).

Climatic factors with (3.04) influence and, finally, education on transmission, had the lowest levels with (2.97) and the influence of ratio. In the vision of drivers, schooling is needed for the load, due to the operation and the rules imposed on the bases, as for transport, understand that your experience is sufficient to prevent accidents and contamination. The following will be considered delivery to clients.

Customers are consumers of fuel, also called point of consumption, where it made the delivery of fuel, the studies found for this level limited to gas stations.

The results regarding delivery, stress ranks first such transport, with (3.51) ratio, customer relationship follows with (3.45) of influence, these two factors are justified by the fact that drivers receive a lot of pressure on delivery by customers, especially in positions where they are not required to expedite the delayed delivery in some cases, are forced to do the necessary isolation of the discharge area to gain time delivery. It is necessary to take into consideration that the posts are constructed on an area of contention and, in case of a possible stroke, fuel is channeled into the separation box, reducing possible contamination and, for consumers, often no all this infrastructure (which may be cited nautical supplies, and agricultural earthworks, where the supply is made directly in the tank of machines), leading us to conclude, then, that the contamination is much greater in the latter case, there may be a real control over these contaminations.

For downloading on customers, drivers receive guidance and specific courses, with customers in accidents may occur, spills, leaks, and consequently contamination to humans and the environment, so it is the place where accidents can occur for large or small proportions.

Conclusions

The research aimed to understand the physical distribution of secondary fuels in the bases of Santa Catarina from the perspective of environmental management. To achieve this goal we interviewed 201 drivers responsible for fuel distribution in secondary bases of Santa Catarina.

When analyzing the results showed that, in general, the trainings have high average, with emphasis on training for discharge, it was also clear that the contaminations occur throughout the process. Starting with the load spills that occur for various reasons, either in equipment or operational failure on the part of drivers and loaders, also contacted that not all spills are declared by the bases loaded. This fact not only is more worrisome because the foundations built on an area of contention and in the case of a spill fuels are channeled into the boxes separator.

In road transport between the base and the point of consumption, whether for gas stations or consumers the variables that most influence traffic and stress and these variables are directly related, another point that draws attention is the fact that drivers confirm that exceed the speed limit. In the view of motorists variable that influences and less schooling to judge that experience is the key to perform the function.

The delivery of fuel is more vulnerable to contamination site, because many facilities are not suitable as supply nautical, agricultural and earthmoving. At these points of discharge many supplies are made directly in warehouses and on own machines increasing the risk of contamination.

This research aimed to contribute to the analysis of physical distribution of fuel, and the process was analyzed in three levels, loading, transportation and delivery. It is important to examine in future studies the contamination on consumers, businesses earthmoving, agricultural and nautical supplies, in order to build a solid knowledge to avoid environmental contamination.

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