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Inc.

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A PIPE CLEANING MACHINE

ERIP Recommendation #571

Prepared for

**U.S. Department of Energy
Office of Inventions and Innovation**

by

**National Appropriate Technology Assistance Service (NATAS)
Operated by
National Center for Appropriate Technology (NCAT)**

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EXECUTIVE SUMMARY

Background

The world's largest concentration of energy transmission pipelines is located in the U.S. Most of these lines have been in service for at least 30 years and are increasingly in need of rehabilitation due to the deterioration of exterior pipeline coating.

The subject invention, a unique pipe cleaning machine known as the "Buffy," was developed by Mr. Harold Bratcher, Jr., V.P., Plan B Pipeline, Inc. The device is used to remove deteriorated wrapping and undercoating from the exteriors of pipelines. The Buffy is comprised of a series of motor-driven metal brushes mounted on a double-ring carriage that surrounds the pipe. The unit is capable of being adjusted to fit pipes up to 36" in diameter. The inventors have applied for a patent.

Pipeline Rehabilitation

For the purpose of this report, pipeline rehabilitation is the process of excavating down to a weakened pipeline, stripping it of old coating, cleaning it thoroughly to a specified finish, and then recoating it and re-burying it. Depending on the coating specified by the pipeline owner, the line may have to be abrasive-blasted immediately after the cleaning process to maximize the bonding capacity of the new coating. When dictated by the coating, abrasive-blasting involves a separate step in the rehabilitation process, regardless of which cleaning technique is employed.

Pipeline cleaning techniques range from manual operations using in-house staff wielding chisels and knives, to automated knife and brush machines, to high-pressure hydroblast equipment. The technique best suited to a project will be determined largely by the length of the line to be rehabilitated, the timeframe involved, whether the line can be taken out of service, and a host of other considerations.

The Subject Invention's Opportunities...

The subject invention can claim several advantages over existing cleaning technologies. It is faster, less labor-intensive, more effective, and more economical than conventional manual cleaning processes and automated knife and brush machines. In relation to conventional hydroblasting, which until recently was reserved primarily for larger projects, the "Buffy" is much less equipment intensive, and presumably less expensive. In addition, the unit is easily transported and capable of being adapted to varying pipeline conditions.

The "Buffy's" niche is clearly in the rehabilitation jobs of 2 miles or less. Tight construction and maintenance budgets within the stalled oil and gas industries mean that most rehabilitation work over the next several years will be these smaller jobs. Overall, pipeline authorities have estimated that approximately 50,000 miles of pipeline will need rehabilitation within the next 10 years, with 6,000 miles falling in the next three years.

... and Barriers

The greatest obstacle confronting the "Buffy" is the common perception that automated knife and brush machines are incapable of providing a satisfactory result except on the easiest, shortest projects. Some of the specific concerns raised seem to have a degree of merit, while others do not. In the end, these objections, which are generally based on earlier, less-capable automated equipment, will be overcome only through repeated and successful demonstrations.

A second significant obstacle may be the competition provided by relatively new hydroblast equipment that is reportedly well suited to smaller rehabilitation projects. This equipment appears to be extremely effective in many respects, though it is still burdened by excessive equipment requirements, which will likely result in a higher per foot cost. The drawbacks of this down-sized hydroblast system do not immediately outweigh the positive attributes, however, and it cannot be overlooked as a source of serious competition.

Finally, a review of the market potential for the "Buffy" or any other pipeline rehabilitation equipment should include consideration of the long-term outlook for the pipeline infrastructure. As promising as the outlook for rehabilitation may be, the projections must be tempered by the Gas Research Institute's forecast for substantial new pipeline construction in regions that are not currently major gas exporters. According to GRI, these new lines will be constructed in lieu of many of the older, existing lines. If these forecasts are realized, the pipeline rehabilitation industry may be somewhat impeded over the next decade and beyond.

I. Introduction

The U.S. energy pipeline network is comprised of gathering, distribution, and transmission pipelines totaling over 2 million miles. Some of these pipelines were installed in the early 1900s, and most have been in service for at least 30 years. Much of this infrastructure is approaching or has reached its design life. It is estimated that 50,000 miles of U.S. pipeline will require rehabilitation or other corrective measures within the next ten years, and 6,000 miles will need rehabilitation within the next three years.¹

Before being buried, transmission pipelines are coated with a corrosion inhibitor, then wrapped with protective tape. Over time, most pipe coating materials deteriorate and must be replaced. Consequently, a pipeline rehabilitation industry has emerged and is growing as the pipeline infrastructure ages.

The rehabilitation process involves excavating and cleaning the affected stretch of pipe, removing the old coating, and returning the surface to a finish intended to maximize the bond with the new coating. There are various means of cleaning pipeline surfaces to the desired finish, ranging from manually operated hand tools, to automated brush and knife equipment, to high-pressure hydroblasting.

The subject invention, "A Pipe Cleaning Machine," known as the "Buffy," is a device that strips pipeline of its coating down to the metal. The apparatus consists of a series of motor-driven metal brushes mounted on a ring structure that fits the around the pipe's circumference. Once stripped, the pipeline may or may not be abrasive-blasted, but is then coated and wrapped, and the trench is back-filled. Present models of the Buffy can be used on pipe up to 36" in diameter. One of the device's unique features is its ability to operate while the pipeline remains in service.

II. Review of the Pipeline Industry

A. Overview

The continental U.S. contains approximately 2.1 million miles of gathering, transmission, and distribution pipelines carrying natural gas, crude oil, and refined petroleum products (collectively referred to as "liquids"). Of this number, natural gas transmission pipelines total 275,000 miles, and liquids transmission pipelines total 150,000 miles. The remaining 1.675 million miles of pipeline are gathering and distribution lines that are typically not coated and wrapped,² and are of little measurable consequence to the subject invention's potential market.

Depressed natural gas, crude oil, and refined products prices during 1991 did not dampen pipeline companies' interests in gaining access to new markets or new sources of supplies.³ In 1990 and 1991, respectively, 10,500 and 7,400 miles of new natural gas pipelines were constructed, while 1,350 and 1,280 miles of new liquids pipeline was constructed.⁴ New gas and liquids pipeline construction in 1992 is estimated at 4,000 miles and 1,300 miles, respectively.⁵

Enron Corporation, the largest natural gas pipeline company in the U.S., conducted a survey of pipeline construction projects in late 1991. The survey indicated that 42 percent of the proposed new pipeline projects nationwide are located in the West Coast-Rockies region. Margaret Carson, Director of Comparative Analysis at Enron Corporation, states, "Although all the proposed projects are not expected to be built, and others may slip their completion dates by a year or more, at least two out of three of these projects will eventually be completed." ⁶

Source: 1987 Baseline Projection of U.S. Energy Supply and Demand, Gas Research Institute

Source: 1987 Baseline Projection of U.S. Energy Supply and Demand, Gas Research Institute

Most of the land-based U.S. transmission pipelines were put into service in the 1950s and 60s, although some pipelines have been in service for more than 50 years.⁷ The West South Central region of the country contains the oldest and greatest mileage of transmission pipelines traveling to the North Central and East South Central regions (see map above). As

dwindling supplies cause exports of natural gas from the West South Central U.S. to decline, pipelines from the Mountain region and western Canada will increase supplies to the North Central region. ⁸

According to the Gas Research Institute's 1987 Baseline Projection of U.S. Energy Supply and Demand, natural gas transmission from the West South Central states to the North Central states and California will have almost disappeared by the year 2000 (see map above). These states, along with the Atlantic states, will receive their supply of natural gas from the Mountain states and Canada. If these projections are reasonably accurate, there may be a gradual build-up of pipeline in the Mountain states and Canada over the next decade, and a decline in the number and miles of pipelines in use in the Southwest Central region.⁹

B. Pipeline Protection

Transmission pipelines are typically buried underground. As a measure against corrosion and stress corrosion cracking, pipelines are coated and cathodically protected. Today, pipelines are coated with sophisticated epoxies, but polyethylene and other tape coatings were generally used in the 70s. Mastics comprised of combinations of asphalt, sand, coal tar enamel, and asbestos (estimated to be present on 20%-25% of the operational pipelines)¹⁰ were the typical wraps used in the 1950s and 60s. These wraps had a projected service life of 30 years, which industry experts have confirmed to be accurate.¹¹

There are several factors that cause pipeline wrapping to deteriorate. Typically, high pipeline operating temperatures and various environmental factors are the greatest contributors. Temperatures of natural gas rise when it is compressed at the time it enters a pipeline. The temperature of crude oil and refined products can also vary. If a pipeline does not have after-coolers to regulate product temperature, the pipeline is continually expanding and contracting, which degrades its wrapping. The most common environmental factors that affect pipeline wrapping are varying soil composition, temperature, and moisture conditions; ground movement from frost heaves and earthquakes; and river crossings.¹²

As a pipeline's coating deteriorates, its cathodic protection is weakened. The cathodic protection current can be increased by adding additional point source anodes. However, once a pipeline wrap has deteriorated to the extent that increased cathodic protection only invites more damage, complete reconditioning is the sole solution.¹³

III. Pipeline Rehabilitation

Pipeline owners have been working for years to extend the safe, reliable operating life of energy pipelines. Pipelines are inspected regularly to determine their operational condition, satisfy government regulations, and quell social concerns. The U.S. Department of Transportation (DOT) requires operators to prove that their pipelines are in safe operating condition and free from defects that would lower a pipeline's operating specifications. Citizens and ad-hoc groups have influenced government regulations on pipeline safety and operations. DOT regulations provide a strong incentive for pipeline rehabilitation.¹⁴

Given the depressed state of the domestic oil and gas industries, government regulations may also be the only reason for most of the rehabilitation work performed over the next several years. Poor industry economics are causing many larger rehabilitation projects to be tabled until budgets can rebound. Most companies, instead, are planning to address only those rehabilitation projects that are required through the DOT. These projects are typically smaller jobs in response to incidences of failed cathodic protection. It is expected that the majority of pipeline rehabilitation jobs during at least the next two to three years will be these smaller projects.¹⁵

A. Rehabilitation Procedures

The rehabilitation procedure selected for a given project can depend on many factors, but primary among them are the length of line to be rehabilitated, the timeframe involved, whether the line can be taken out of service, and the composition of the pipeline wrapping. Depending on the nature and extensiveness of a rehabilitation project, the pipeline owner/operator determines whether in-house maintenance personnel or a pipeline rehabilitation contractor are best suited for the job. Typically, on relatively short stretches of pipe or areas requiring only a patch, in-house personnel perform the work. Otherwise, the work is contracted to a company that specializes in pipeline rehabilitation.

Because of the immediacy of having to coat a pipe soon after it has been cleaned and primed, companies that specialize in rehabilitation are generally capable of performing all aspects of the rehabilitation process. Pipeline rehabilitation contractors must also contend with asbestos wrapped lines. Due to the Environmental Protection Agency's asbestos removal regulations, contractors must have equipment that prevents asbestos from entering the atmosphere and soil.

Spot Jobs

Patching and smaller, easier jobs -- particularly those that do not require the pipeline to be taken out of service -- are often performed by the pipeline owner's in-house maintenance crew. In these cases, special knives, chisels, and brushes are applied manually to prepare the pipeline surface for necessary repairs and subsequent recoating. This process is time-consuming and labor intensive, and results are inconsistent, often resulting in disfigured and scarred surfaces that will not allow the coating to properly adhere to the surface. For these reasons, manual cleaning is suitable only for the smallest spot jobs. If asbestos is present in the wrapping, manual cleaning cannot be employed because the asbestos cannot be contained.

Projects Exceeding 2 Miles

At the opposite end of the spectrum are the large, more difficult jobs that extend five to ten miles or more. For these projects, the industry-preferred cleaning process is hydroblasting -- the use of high-pressure (17,000 to 25,000 pounds per square inch) water. High-pressure water applications are not new to many industries, but hydroblast cleaning of pipeline has been practiced for only the last three to four years.

Hydroblasting offers several benefits, including speed and effectiveness. Depending on the pipeline diameter and the coating that must be removed, hydroblasting is capable of thoroughly cleaning pipeline at the rate of up to 13 feet/minute. During a typical 10-hour day, which includes an estimated six full working hours, hydroblasting can clean close to a mile of pipeline.

However, traditional hydroblasting operations also involve certain features that make this process unsuitable in many situations. For instance, removal and containment of mastic comprised of asbestos is difficult at best. Also, hydroblasting usually requires that the pipeline be taken out of service to enable the line to be exhumed and laid alongside the trench. Taking a line out of service can mean interruptions to customers who rely on the line, as well as possible environmental risks from "blowdown," the process of clearing the line of the product it carries. Moving extended lengths of pipeline also increases the chance of stress damage.

Once a pipeline has been moved to the surface, the hydroblasting process is labor- and equipment-intensive, making it inappropriate for use near buildings or in other confined areas. Additionally, hydroblasting is relatively expensive, costing up to \$30-\$35/foot or more before taking into account the inconvenience and revenue loss from "blowdown."

For these reasons, it makes sense that the benefits of hydroblasting would be best realized during larger jobs. A representative of one major hydroblast contractor, R. F. Yockey and Company, confirmed this conclusion, stating that his company usually seeks projects involving at least 10 miles of pipeline. A representative of CRC-Evans Rehabilitation Services, the other major hydroblast contractor, took exception to this conclusion, however, stating that his firm's hydroblast equipment is economical on all but the smallest jobs. He indicated that even small projects are considered if a number of them are planned for the same geographical area. He also explained that pipeline is taken out of service and exhumed not because of hydroblasting's need to have the line above ground, but because of safety considerations. He stated that CRC-Evans is fully capable of cleaning the pipeline while it remains in the trench and in service.

Projects 2 Miles Or Less

In between manual cleaning and hydroblasting are automated knife and brush systems that are well suited to small to medium jobs (up to one to two miles). In the past, an automated-knife machine that operated similarly to the subject invention was also used. Discussions with industry contacts regarding this machine, however, indicated general agreement that it is neither effective nor safe, often leaving unintended gouges and cuts in the pipeline surface. All contacts dismissed this machine as an inconsequential competitor, so it received no further attention.

CRC-Evans also employs an automated-brush machine on certain smaller jobs. This machine is capable only of moving around the pipeline and is unable to be moved repeatedly over a stubborn section of old coating. Nor do the unit's brushes rotate. Thus, the subject invention appears to be the superior automated-brush entrant.

Though hydroblasting has been used predominantly on larger (multi-mile) rehabilitation projects, CRC-Evans has also apparently developed a down-sized hydroblast unit suitable to smaller projects. This unit, called the Bellhole Rehabilitation System (BRS), has reportedly performed rehabilitation work on "bellholes" (much shorter pipeline sections) of as little as 40 to 120 feet without taking the line out of service. Like conventional hydroblast operations, the BRS still requires substantial levels of equipment and water, but claims to offer unique capabilities that set it above other pipeline cleaning technologies.

B. Competitive Environment

The subject invention appears to overcome the many drawbacks of manual pipeline cleaning procedures. The former is quicker, more effective, and safer to the pipeline than manual cleaning operations. Additionally, the "Buffy" can be encased in order to capture asbestos debris.

For projects under a mile or two that do not require taking the line out of service, the subject invention also appears to be superior in many respects to the hydroblasting techniques traditionally used for large projects. The "Buffy" does not involve any special line-travel equipment, pipeline booms, or water transportation and storage equipment, all of which add to the project cost.

There are concerns, however, that the subject invention will have to compete head-to-head with CRC-Evans' BRS. Information provided via literature, video, and interviews indicates that the BRS' major drawbacks -- greater equipment needs, which presumably lead to higher costs -- may be outweighed by the unit's speed (up to a reported 25 feet/minute), diversity (capable of self-propelled cleaning in one direction, followed, if necessary, by abrasive blasting when reversed), and effectiveness (thorough, one-pass cleaning reportedly capable of handling virtually all coatings as well as all pipe-surface joints and other anomalies). In addition, the BRS' capability to rehabilitate lines while they remain in service nullifies this important benefit claimed by the "Buffy."

A related issue is the fact that CRC-Evans is a well-financed company with the resources necessary to properly commercialize its hydroblast systems. Its standing in the industry has enabled CRC-Evans to attract additional technology development support through separate joint venture arrangements with AllWaste, a growing materials disposal company, and the Gas Research Institute. The latter is particularly interested in working with CRC-Evans to develop an improved asbestos-removal system and reportedly has contributed substantial financial resources to the effort.

IV. Barriers

The subject invention faces several obstacles, led by the industry's perception that brush cleaning systems, in general, are too slow and not sufficiently thorough to be useful in any but the smallest and easiest rehabilitation projects. There is also a sense that brush cleaning systems are incapable of meeting the higher-level surface finishes often required in bid documents, and that they are ill-suited to longer jobs because of the risks associated with (1) not properly supporting the pipeline during the cleaning/recoating process and (2) not taking the pipeline out of service.

Some of these concerns are valid and should be considered as barriers toward successfully commercializing the subject invention, but others appear to have no merit:

- > On the issue of speed, or production rate, the subject invention is unable to compete head-to-head with hydroblast equipment once the pipeline has been prepared for the cleaning process. However, a proper comparison between the "Buffy" and hydroblasting should consider the lead time to transport and prepare the hydroblast equipment, and to "blowdown" and exhume the line if it is taken out of service. The subject invention may compete well with hydroblasting when lead time is taken into account.
- > On the issue of surface finish, it is important to clarify that the rehabilitation process involves first cleaning the surface to a level specified by the pipeline owner and defined by the National Association of Corrosion Engineers. There is no evidence that the subject invention cannot achieve this finish on most jobs; the exception is when the old coating consists of epoxy and other difficult substances, which hydroblasting also sometimes cannot thoroughly remove. When this situation arises, regardless of the primary rehab method employed, abrasive-blasting is employed to remove the remaining old coating.

Once the pipe surfaces is completely clean, the surface may or may not have to be sand-or grit-blasted to leave an "anchor" pattern to improve the adhesion of the new follow-on coating. When called for, abrasive-blasting must occur regardless of whether hydroblasting or the subject invention is used in the cleaning process. Whether abrasive-blasting is required depends largely on the nature of the project and the desired result. There appears to be a trend developing toward coatings that do not require a particle-blasted anchor, but this trend is likely to benefit all cleaning technologies equally.

- > On the issue of proper pipeline support, there is legitimate cause for concern that exposing too much line without adequately supporting it during the rehabilitation process will result in serious stress damage. The inventor claims to address this issue by strategically placing pillows under the exposed line. Still, concern over pipeline support is a potential market barrier, and only through demonstration and experience will the inventor be able to alter the industry's position on this issue.
- > On the issue of safety risks from not taking the line out of service, there may again be legitimate cause for concern. Hydroblast contractors, as well as pipeline owners, claim that a major reason for taking the line out of service is to avoid potential accidents during the rehabilitation process. They also admit, however, that there are many occasions in which the interruption would simply be too great, so the rehabilitation must be performed while the line remains in service. Clearly, the decision is a subjective one determined by a careful risk/benefit analysis. Toward marketing the subject invention, the issue of safety and liability should be addressed as it appears to be a barrier.

Competition posed by CRC-Evans' BRS technology and the company's substantial resources represents another potential barrier. The key question is whether the BRS can or cannot compete head-to-head with the "Buffy," an issue that should be further investigated, but one that will best be determined in bid award announcements.

More of a consideration than an outright barrier, still another issue involves the likely geographical shifts in the pipeline infrastructure over the next ten years. Leading industry experts estimate that few, if any, natural gas and crude oil transmissions from the Southwest Central states to the North Central states and California will occur by the year 2000. Instead, a gradual build-up of pipeline transmitting primarily natural gas from the Mountain states and Canada to California, the Midwest, and Atlantic coast is expected. If these forecasted changes occur, long stretches of pipeline are likely to be abandoned, not rehabilitated, and replaced with new pipeline in different geographical regions.

There is no empirical way to determine the likelihood of such an occurrence, or the extent of the pipeline taken out of service if these forecasts come to fruition. Nonetheless, the possibility of a number of miles of pipeline being taken out of service, thereby reducing the need for rehabilitation, should be a consideration throughout the decade and beyond.

V. Summary

The subject invention is best suited for projects of one to two miles or less. It is superior in most respects both to manual cleaning with chisels and knives and to the few remaining automated knife and brush systems.

The subject invention can also claim important advantages over the hydroblast process traditionally used in larger rehabilitation projects. Most notable among these advantages are the reduced equipment needs of the "Buffy" and its ability to perform while the pipeline remains in service. In truth, however, the "Buffy" and large-scale hydroblasting should not be competitors, because they have traditionally targeted different market segments.

On the other hand, this situation may change if CRC-Evans has, as claimed, developed a hydroblast technology that can economically rehabilitate shorter stretches of pipeline without taking them out of service. Until this development can be verified, however, and its capabilities determined, the subject invention should expect to capture an increasing number of smaller projects as the rehabilitation industry expands.

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Telephone conversation with Gary Walker, VP - Engineering and Construction, Pacific Gas Transmission Company, June 2, 1992.
- ³ "U.S. Natural Gas Pipeline Flow and Demand Trends," Pipeline and Gas Journal, January 1992, pages 26-29.
- ⁴ *Ibid.*
- ⁵ "Industry to Trim Spending in U.S. During 1992," Oil and Gas Journal, February 24, 1992, pages 25-28.
- ⁶ See note 3 *supra*.
- ⁷ See notes 1 and 2 (Walker conversation) *supra*.
- ⁸ "The Long-Term Trends in U.S. Gas Supply and Prices: 1987 GRI Baseline Projection of U.S. Energy Supply and Demand to 2010," Gas Research Insights, December 1987, page 23.
- ⁹ *Ibid.*, pages 24-25.
- ¹⁰ Telephone conversation with Robert Buhrow, NIST consultant, June 1, 1992.
- ¹¹ See note 2 (Walker conversation) *supra*.
- ¹² *Ibid.*
- ¹³ See note 1 *supra*.
- ¹⁴ "Ultrasonic I-Service Inspection," Pipeline and Gas Journal, March 1991, page 21.
- ¹⁵ Telephone conversation with Russell Matthews, Editor, Pipeline Intelligence Report, June 1, 1992.

PROJECT REVIEW

A copy of NIST Evaluator Jogindar S. Dhillon's Final Technical Review, the Second-Stage Evaluation Report conducted and completed by Robert P. Buhrow, consultant, and the submission made by the inventors, Harold Bratcher, Jr., Woodrow Bratcher, and Ronald Schwarz, were reviewed by the NATAS market assessment team.

Team members then contacted individuals in the following associations that are versed in the energy pipeline industry:

- ◆ Interstate Natural Gas Association of America
- ◆ American Petroleum Institute
- ◆ Association of Oil Pipelines
- ◆ Eno Foundation for Transportation, Inc.
- ◆ Gas Research Institute
- ◆ National Association of Pipeline Coating Applicators

These conversations further familiarized the market assessment team with the pipeline industry and its growing rehabilitation segment. Numerous names of industry authorities were provided by the associations, as well as suggestions of key industry publications to review.

Meanwhile, the assessment team provided a database search specialist with key terms to facilitate a database search. The search specialist first accessed "DialIndex," enabling her to review groups of databases organized by broad topic area. The topic areas targeted included oil, gas, and water pipeline, pipeline cleaning, recoating, rehabilitation, and maintenance. Following up on identified "hits," the database search specialist printed out abstracts, articles, and other potentially valuable information. Ultimately, the search produced one article that contributed toward the market assessment study.

While the database search specialist was gathering information, the assessment team made telephone contacts with pipeline industry practitioners to obtain feedback concerning the subject invention's technology and to inquire about other competing technologies. These conversations proved invaluable to the market assessment study.

The investigators also drew heavily from the resources at the Montana College of Mineral Science and Technology's library, which contains a variety of publications and periodicals on the energy industry, such as Oil and Gas Journal, Pipeline and Gas Journal, and the 1992 Hart Petroleum Directory.

Overall, the final market assessment is a result of a combined effort involving both primary and secondary research methods. Each research approach - personal conversation with related associations and industry authorities, literature review, and database search - contributed uniquely to the final product.

DEPARTMENT OF ENERGY**TECH BRIEF****JUNE 1994****A PIPE CLEANING MACHINE**

[ERIP 571-1.TBR]

A mechanical device for cleaning the outer surface of existing underground pipelines used for carrying natural gas and petroleum products.

Introduction

As the interstate pipeline infrastructure ages, corrosion of buried pipe results in serious leaks. Leaking sections of pipeline are usually excavated for repair. Existing insulation and protective coatings must be stripped off prior to repair, recoating and reinsulation operations. This process is time consuming, labor intensive and expensive due to pipeline shutdown, product waste, and either tedious manual cleaning or capital intensive hydrocleaning. Periodically, sections of pipeline are also excavated for inspection to assess pipeline condition. If inspection reveals corrosion, pipelines are often shut down and removed to accommodate refurbishing and repair. This process is extremely expensive and disruptive to pipeline operations.

Design Benefits

The pipe cleaning machine (PCM) invention consists of a double ring carriage and a series of wire brushes mounted on spring-loaded brackets. The brushes are driven by individual pneumatic motors. A distribution box is mounted on the carriage to distribute power in the form of electricity or compressed air. Power is supplied to the carriage through a cable (or a hose) from a diesel-generator (or diesel-compressor set).

The PCM offers a partially mechanized method for cleaning pipe. The carriage of the PCM is configured to open and close so as to concentrically surround the pipeline and place a series of rollers in contact with the pipe so that the movement of the carriage is facilitated. Cleaning operations are carried out with the pipeline in service. Earthen fill is removed with a backhoe to expose the pipe. The pipeline is cleaned in about 40-foot sections since it must be supported at suitable intervals either with dirt fill or some other means. The cleaning apparatus is mounted around the pipe by hand, or, for larger pipes, with a backhoe. The wire brushes strip off old coatings, tapes and corrosion products formed in the past. Operators wear protective breathing masks to conform with Environmental Protection Agency (EPA) and Occupational Safety and Health Administration (OSHA) regulations.

Operational Benefits

One major advantage of the pipe cleaning invention over conventional pipecleaning methods is that the pipeline need not be taken out of service while the cleaning operation is performed. In fact, the pipeline does not even require removal from the trench, which eliminates undue stresses along the pipe length. Use of the PCM invention would provide a major economic benefit to pipeline owners by eliminating waste generated from product lost when emptying the pipeline and from pipeline downtime. Advantages of PCM use over current manual pipecleaning techniques include reduced cost, consistency of high quality, cleaning, and increased automation.

When compared with hydroblasting techniques, the invention offers reduced cost and increased utility by elimination of high water usage and reduction of equipment requirements such as a side boom, high pressure pump skid, and a water tank. The PCM invention is, however, quite a bit slower than hydroblasting, although multiple devices could be used to expedite the cleaning process.

DOE Sponsorship

Energy-Related Inventions Program Final Technical Review Number 571 identified the PCM invention as worthy of appropriate government support. Government assistance is needed to develop larger versions of the PCM and for marketing at the national level.

Market Potential and Status

The PCM invention should find a significant market where conventional methods are either not suitable or economically viable. One of the major incentives to pipeline owners is that the pipeline not be taken out of service while it is being worked on.

Inventor's Goals

Mr. Harold Bratcher would like to see his invention demonstrated and commercialized to maximize the output of modern oilfield operations.

Patent Status

The inventor's have applied for a patent for the cleaning device.

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