

Reform of Elastic-Plastic Mechanics and Strength Design of Pipelines Based on Ideological and Political Education

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ABSTRACT

Oil and gas storage and transportation safety courses are very important in oil and gas storage and transportation engineering. With the ideological and political construction of the course in the new period, the mode of professional knowledge teaching cannot meet the teaching requirements. The teaching team has been practicing in the course for many years. By inserting typical characters, typical projects, national policies and industry trends into the course, students' patriotism, academic confidence and environmental protection awareness have been cultivated, and remarkable results have been achieved. At the same time, it can provide some reference for the ideological and political education of engineering majors.

1. Introduction

With the frequent occurrence of oil and gas pipeline accidents in recent years, petroleum universities pay more and more attention to the teaching quality of oil and gas storage and transportation engineering safety courses. In order to adapt to the change of the actual form, many petroleum colleges and universities have carried out different degrees of teaching reform^[1,2]. Oil and gas storage and transportation safety courses mainly include *Strength Design and Safety Management of Oil and gas Storage and Transportation Facilities* and *Elastic-Plastic Mechanics*, etc. *Strength Design and Safety Management of Oil and gas Storage and Transportation Facilities* is mainly a course for undergraduates, which focuses on allowing students to understand the calculation method of strength of storage and transportation facilities and master each

step of integrity management. *Elastic-Plastic Mechanics* is a theoretical course for graduate students, focusing on cultivating students' ability to use elastoplastic mechanics knowledge to solve practical engineering problems. These safety courses are of great significance for training storage and transportation professionals.

In 2016, General Secretary Xi Jinping stressed that ideological and political work should run through the whole process of education and teaching and create a new pattern for the development of higher education in China at the National Conference on Ideological and Political Work in Colleges and Universities^[3]. In 2017, the report to the 19th National Congress of the Communist Party of China (CPC) also clearly pointed out that the fundamental task of cultivating moral education and cultivating people should be carried out to train socialist builders and successors with all-round moral, intellectual, physical and aes-

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thetic development. In 2018, General Secretary Xi Jinping delivered an important speech at the seminar of teachers and students of Peking University, in which he pointed out that China needs to further strengthen the reform of higher education. In 2020, the Ministry of Education issued the Guidelines for Ideological and Political Construction of Higher Education Courses, requiring ideological and political education to be integrated into the personnel training system, especially to comprehensively promote ideological and political education in higher education institutions and improve the quality of personnel in higher education institutions^[4]. In the following national Education conference, General Secretary Xi Jinping emphasized the integration of "enhance morality, foster talents" into all aspects of school education^[5]. Ideological and political education is one of the important measures taken by a large number of colleges and universities in response to the call of the state, as well as an important measure of educational reform in the new era. Ideological and Political courses will integrate ideological and political education into all disciplines, in teaching student's professional knowledge at the same time to expand students' social and political vision, guide students to accept positive socialist political thought and excellent traditional virtues of the Chinese nation, so as to cultivate students into high-quality talents in the new era^[6].

The safety courses of oil and gas storage and transportation engineering are so professional that the traditional ideological and political education courses are easy to produce "two layers" phenomenon when integrated into such classes, which may waste lot of teaching resources. Therefore, it is necessary to carry out appropriate curriculum reform to make ideological and political education efficiently integrated into the safety courses of oil and gas storage and transportation engineering^[7].

2. Course Status

Take *Strength Design and Safety Management of Oil and Gas Storage and Transportation Facilities* and *Elastic-Plastic mechanics* as examples. *Strength Design and Integrity Management of Oil and Gas Storage and Transportation Facilities* first carried out substantive teaching reform, which was combined by *Pipeline and Tank Strength and Safety* and *Integrity Management of Oil and Gas Storage and Transportation Facilities*, involving huge content and extensive knowledge. With the large-scale construction of national storage and transportation facilities such as pipelines and tanks, many old standards and methods are no longer applicable and students need to be introduced to the latest standards and specifications related to their majors. Because oil and gas storage and

transportation are a very large and complex system, and pipeline accidents occur frequently in recent years. The integrity system of pipeline and storage tank has been paid more and more attention. After the merger, the new curriculum includes a unique training program designed to improve students' practical application of the knowledge they have learned. Compared with previous courses, this course reduces the proportion of traditional closed-book exams, and pays more attention to the examination of master students' practical training projects, so as to continuously improve students' ability to understand, master and use knowledge.

Elastic-Plastic Mechanics is a theoretical mechanics course. As a branch of solid mechanics, it is a course specializing in the study of the stress, strain and displacement of deforming solid under the action of external factors (temperature, pressure, etc.) and their distribution laws. It is a great challenge for teachers to instruct this course to non-mechanics students. In recent years, this course is also trying to carry out teaching reform. In order to better get close to the oil and gas industry in the teaching, many classic cases are integrated into the classroom. A large number of cases are analyzed by elastoplastic mechanics knowledge so that students can connect the knowledge with the actual. Currently, there is no elastoplastic mechanics textbook suitable for the oil and gas industry. The teaching team combines years of teaching experience to compile the elastoplastic mechanics textbook. The textbook focuses on theoretical explanations and combines knowledge of the oil and gas industry with the aim of teaching students' basic theories, and then students can improve their ability to use knowledge through practical cases in the book.

3. The Dilemma of Ideological and Political Teaching

At present, the ideological and political education courses of the university are still mainly taught by teachers from the School of Marxism. In the undergraduate stage, there are *Ideological and Moral Cultivation and Legal Foundation*, *Introduction to the Basic Principles of Marxism*, *Outline of Modern Chinese History* and *Introduction to Mao Zedong Thought and Socialism with Chinese Characteristics*. For graduate students, there are courses such as *Research on theory and Practice of Socialism with Chinese Characteristics* and *Dialectics of Nature*. These courses focus on ideological and political education for students, but they focus on the theory and system of knowledge in the teaching, and the memory of knowledge points in the exam, resulting in many students' mind wandering in class and reciting before the exam.

Obviously, this teaching method cannot meet the increasingly important ideological and political education objectives. In response to this phenomenon, many colleges and universities have carried out corresponding teaching reforms, such as "smart classroom", "flipped classroom" and other new teaching methods^{[8][9]}. These innovative teaching methods break the traditional classroom teaching mode and improve the quality of teaching. However, due to the large classroom teaching, students of different majors are in the same classroom, ideological and political education is difficult to involve students' own field, cannot fully mobilize students' enthusiasm in the classroom, and reduce the quality of ideological and political education classroom.

The quality of ideological and political education can be improved by conducting ideological and political education to students by teachers of this major. However, too much ideological and political education will obviously occupy the time of many specialized courses, resulting in the deterioration of the teaching quality of specialized courses. In the teaching process, because the ideological and political education content is relatively easy to learn, it is easy to lead to students' weariness of more difficult knowledge points.

4. Attempt and Exploration of Curriculum Reform

In the new era, it is extremely urgent to integrate ideological and political education into the whole teaching process in order to carry out the two major educational tasks of "cultivating moral characters" and "cultivating socialist builders and successors". China University of Petroleum (Beijing), as a domestic petroleum institution of higher learning, has explored an ideological and political education curriculum reform suitable for oil and gas storage and transportation safety courses.

4.1 Introduce the Patriotic Story of Oil Workers

It is very important for teachers to give students an impression at the beginning of the course. At the beginning of the course, introducing the patriotic story of the famous oil workers can enhance students' recognition of the course and even professional pride. Therefore, the early design of the course requires teachers to vividly introduce the patriotic story of the oil men to students.

From "iron man" Jinxi Wang, to "new era iron man" Qimin Wang, and then to "Daqing new iron man" Xinmin Li, there have been three generations of "oil iron men" in China's oil industry. Jinxi Wang, as the first generation of "iron man", people are most familiar with a sentence is

"would rather live less than 20 years, try hard to win the big oil field". Iron man was the title given to Wang Jinxi by the society at that time. From an ordinary worker to a well-known oil man in China and even the world, he has devoted his whole life to the development of China's oil industry and is a national hero who shares the country's worries. His "iron man spirit" has inspired generations of oil workers^[10] Qimin Wang, as the second generation of "iron man", took base in Daqing Oilfield and put forward the "efficient water injection production method", a new method to stabilize oil production in the middle and low water cut stage. He took 10 years to find out the method of stabilizing and increasing production in Daqing oilfield. After 7 years, Daqing oilfield increased more than 20 geological reserves. After a series of attempt and exploration, Daqing oilfield had maintained a stable production of 50 million tons for 27 years. Qimin Wang has given a new connotation to the "iron man spirit"^[11]. Xinmin Li, as the third generation of "Iron man", introduced China's drilling team to the world. From the expedition in Sudan to Iraq, Xinmin Li created a new name card of "Iron Man" drilling. Xinmin Li let the image of "Iron Man" show a new era style and spiritual temperament^[12].

The introduction of the three generations of oil "iron man" in the course, while carrying forward the "iron man spirit", can deeply infect students, give students a spiritual impact and improve students' political sentiment in the study of professional courses. At the same time, it also stimulates students' fighting spirit to fight for the oil industry, the motherland and the national rejuvenation, and increases students' motivation to learn professional knowledge.

4.2 Cultivate Students' Academic Confidence

In the process of teaching, teachers let students gradually feel the charm of the subject and cultivate students' academic confidence is also an important goal of the course ideological and political. Oil and gas storage and transportation engineering safety courses as an important content of oil and gas storage and transportation engineering safety is an extremely important part of oil and gas storage and transportation engineering. Oil and gas storage and transportation safety includes essential safety, public safety and supply security, and any link problems will lead to very serious consequences. Materials and load factors of pipeline system will cause structural failure of the pipeline due to defects. The nature of oil and gas storage and transportation cannot be guaranteed. Because piping systems inevitably appear Because of inevitable appearance of pipeline system in human living areas, or some ecologically fragile areas, when the essential safety

of the pipeline system is in question, it is easy to cause some disasters, and pose a threat to public safety. At the same time, accidents in the pipeline system may cause the problem of shutdown, leading to some phenomena such as "gas shortage" and "oil shortage", which pose a threat to the supply security. Especially in *Elastoplastic Mechanics* and *Strength Design and Safety Management of Oil and Gas Storage and Transportation Facilities*, the value of some parameters may have a very important influence on the strength of the whole structure, so the correct value must be taken in accordance with the corresponding regulations, rather than the arbitrary value. In practical teaching, some software can be used to simulate the influence of key parameters on the structure, so that students can intuitively understand the knowledge point. At this time, the course ideological and political can start from the macro perspective and introduce some famous projects to students, such as Central Asia oil and gas pipeline, China-Russia crude oil pipeline, China-Myanmar oil and gas pipeline and the China-Russian eastern natural gas pipeline, etc. Among them, from the perspective of energy security, China-Myanmar oil and gas pipeline has created a new energy channel for China, so that China's energy security has been further improved. From the political point of view, the China-Myanmar oil and gas pipeline is not only an ordinary oil and gas pipeline project, but also an important achievement and crystallization of the establishment of diplomatic relations between China and Myanmar for 60 years. The project is mutually beneficial to the people of both countries and has been highly valued by the leaders of both countries. It is also one of the most representative projects in the oil and gas storage and transportation industry. The China-Russian eastern natural gas pipeline adopts the pipe diameter of 1422mm, the high-grade steel of X80 and the operating pressure of 12 MPa, which represents the highest technical level of oil and gas pipelines in China. The China-Russian eastern natural gas pipeline is also an important part of China's four strategic oil and gas channels. It is a major oil and gas pipeline project of strategic significance, which further guarantees China's energy security. By introducing these famous projects in the course, students can have a deeper understanding of their major, feel the process of knowledge transforming into practice, and cultivate their academic confidence, and be confident that what they have learned can have a great potential in engineering.

4.3 Transmit the Concept of Environmental Protection

The transmission of environmental protection concept in the course is based on two aspects. One is the macro

national policy and industry development trend. The other is the oil and gas pipeline industry accident cases. In terms of national policies, China highly values ecological and environmental protection. Guided by the conviction that lucid waters and lush mountains are invaluable assets, the country advocates harmonious coexistence between humans and nature, and sticks to the path of green and sustainable development. At present, China's national energy structure is transforming to low carbon. Carbon dioxide emissions will reach the peak in 2030 and achieve carbon neutrality in 2060. Oil and natural gas plays a pivotal role in the energy transition. China's oil and gas storage and transportation facilities are constantly developing to high quality. In the process of high-quality development, oil and gas storage and transportation security will face more new challenges. The country is bound to invest more forces to strengthen technical breakthroughs. In terms of industry development, with the establishment of the National pipeline network Company, "a national network of oil and gas pipelines" is being built orderly. The establishment of the National Oil & Gas Pipeline Network Corporation is conducive to the rational allocation of oil and gas resources and improve the allocation efficiency of resources. At the same time, the establishment of the national pipeline company can make an overall plan for the construction of national oil and gas pipelines, reduce the waste of pipeline resources and improve the transportation efficiency of oil and gas resources. From the perspective of national policy and industry development trend, while teaching students the concept of environmental protection, students' understanding of oil and gas storage and transportation major is strengthened and their academic confidence is enhanced. Many oil and gas accidents have occurred due to the rapid urbanization of population, frequent occurrence of natural disasters and substandard engineering construction. These accidents not only caused economic losses, but also caused serious ecological losses. The Oil spill in the Gulf of Mexico is an oil and gas accident with a very large impact on the environment. The oil contaminated the ocean area of 100,000 square kilometers with 8,332 species in the affected area. A decade later, high levels of oil contamination are still being found in thousands of fish species, including many popular seafood. It can be seen from this accident that the oil spill has a great impact on the environment. Students can feel the importance of oil and gas storage and transportation safety to environmental protection in this case, and this accident can guide students to establish the concept of environmental protection in their professional study.

5. Conclusions

Oil and gas storage and transportation safety courses include several courses, among which *Strength Design and Safety Management of Oil and gas Storage and Transportation Facilities* and *Elastic-Plastic Mechanics* are the representatives. Such professional and theoretical courses need to deeply explore ideological and political elements of the course, and teach ideological and political contents to students through ingenious design by teachers. At the beginning of the course, the oil spirit is used to guide students' patriotic feelings, and typical projects are inserted into the course to enhance students' academic confidence. At last, the course is closely related to the realistic development of the country and the industry, and constantly transmits the latest ideological and political knowledge to students. In recent years, the teaching team has constantly deliberated and designed ideological and political elements in the course of oil and gas storage and transportation safety, which has improved the quality of ideological and political construction of the course and gradually achieved the effect of "Mute, it moistens each thing". The ideological and political elements of oil and gas storage and transportation safety courses are far more than these. In the future, it is still necessary to further explore, accumulate and utilize ideological and political elements to make unremitting efforts to improve the quality of education and teaching.

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