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Effect Evaluation and Research of Oil Heated and Added Depressant on Zhongshanchuan-Jingjiaping Segment of An Yong Oil Pipeline

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Abstract: *In order to solve the problem of condensating tube of An Yong oil line, the author made this study.In fact, the subject is also a complex technical problem of drag reduction, pour point reduction, anti-wear and lubrication on long-distance crude oil pipeline, researching it is very difficult. An Yong oil line is the most complicated pipe at home and abroad. From the "3 • 14" condensating tube accident in 2009, the problem of An Yong oil pipeline in the snow and the rainy season safely operating is the point that Pipeline Transport Company and Yan Chang Oil Group of Shaanxi focus and the technical problems which they will look forward to being solved. The paper uses testing method and screening method. To take only Zhongshanchuan - Jingjiaping segment of An Yong oil pipeline as an example in this article.By laboratory and field experiment the solidifying point of crude oil heated and added depressant of Zhongshanchuan-Jingjiaping segment of An Yong oil pipeline evenly falls 10℃ above,in addition, the results show that effect of BEM-W decoagulant is the best among three depressants-BEM-W, GY-3 and EVA ,which can essentially solve safely operating problem of An Yong oil pipeline being low throughput with wax to ensure that the pipeline does not condensate tube. Therefore, the research of this topic is very meaningful and necessary.*

Keywords: *Heat treatment, BEM-W modification depressant, effect evaluation and research,drag reduction, pour point reduction, anti-wear, lubrication*

1. Introduction

Pour Point Depressant (PPD) is a kind of chemical which can reduce the freezing point of lubricating oil. Many varieties are the same as pour point depressants used in oil and gas production. Types of PPD are alkyl Naphthalene, polymethacrylate, polya-olefin, and so on. Among them, polya-olefin (code name T803) is a new light-colored pour point depressant developed in the 1970s. At present, there are three main domestic pour point depressants: BEM-W, GY-3 and Eva.The pour point depressant BEM-W is prepared by our side in cooperation with Xuzhou Jinqiao Petrochemical Pipeline Technology Company Limited,and its technology is confidential and does not open to the public.

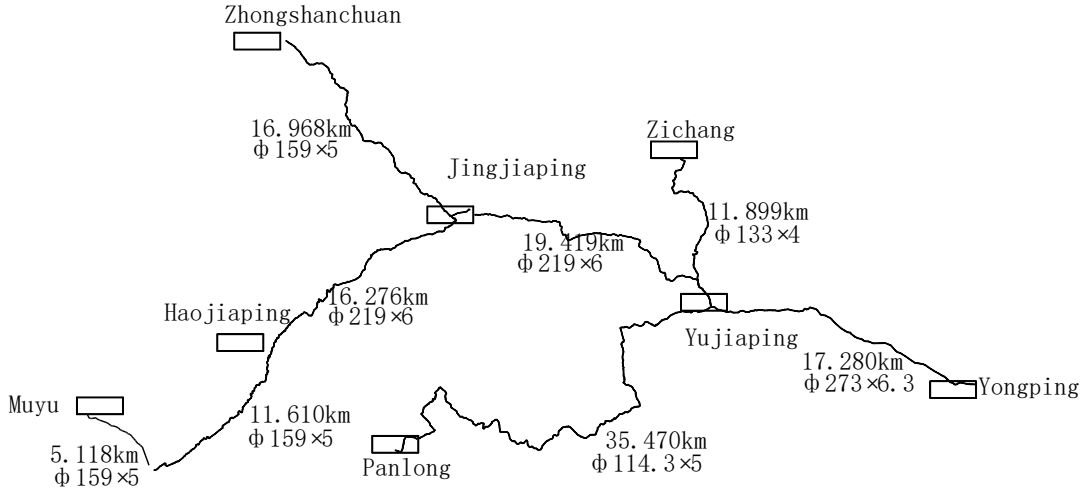

Figure 1 Structure diagram of An Yong oil line

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An Yong oil line is the most complicated pipe at home and abroad.The total length of An Yong oil line is 134 kilometers, whose design transmission capacity is 1.85 millions tons every year, which has 7 pumping stations-Zhongshanchuan station,Muyu station,Haojiaping station,Zichang station,Palong station (now it is out of service),Yujiaping station and Yongping station. See figure 1.

2. Existing problems of an yong oil line

The entire pipeline is at a low volume operation. The actual transmission capacity of An Yong oil pipeline is 1.30 millions tons every year,compared with design transmission capacity 1.85 millions tons every year it is at a low volume operation, especially transmission capacity of Zhongshanchuan station, Muyu station and Palong station are so serious instability that they often appear low volume operation.

According to each pipeline temperature indicators of An Yong oil pipeline, the temperature of Zhongshanchuan-yujiaping oil pipeline and Muyu-Haojiaping-Jingjiaping oil pipeline is usually about 22 ℃, which are very close to crude oil freezing point temperature,so condensating tube risks exist. For example, the "3.14" condensating tube accident occurred on An Yong oil pipeline on the march 14,2009, which caused An Yong oil pipeline to stop operation 7 days.

3. Effect evaluation and research of crude oil heated and added depressant

3.1 Purpose of the experiment

Through the oil laboratory and field experiments to compare the situation of the two lower freezing point, to determine the effectiveness and stability of the pour point depressant,to ensure the safe operation of An Yong oil pipeline at a low volume,to provide the control basis for production operation.

3.2 Laboratory experiment

According to An Yong oil pipeline condensating pipeline hazards, to select to test Zhongshanchuan and Jingjiaping crude oil pour point, and to test their crude oil pour points when Zhongshanchuan crude oil is added BEM-W ,GY-3 and EVA decoagulant crude oil flow improver at laboratory.

3.2.1 Dispensing Method

To add about 99L diese in 250mL grinding mouth jar, to heat to 80 ℃ or so, to add 1g crude oil flow improver,to dissolve 2 hours, to dub 1% (m/v) concentration solution to set aside.

3.2.2 Method of filling depressant

To accurately weigh 100g crude oil,to add the crude oil flow improver of 0.5mL1% (m / v) concentration to solute, to dub 50 mg / kg concentration.

3.2.3 Laboratory experimental results

(1)The laboratory experimental results show after An Yong oil pipeline adds the BEM-W decoagulant crude oil flow improver, crude oil solidifying point significantly falls a big margin at laboratory. From table 1 showing, Zhongshanchuan 1# oil tank adding depressant crude oil outbound solidifying point is 13℃,it falls 10℃ from crude oil solidifying point 23℃, Jingjiaping adding depressant crude oil entering oil station solidifying point is 14℃,it falls 9℃ from crude oil solidifying point 23℃;Zhongshanchuan 2# oil tank adding depressant crude oil outbound solidifying point is 14℃,it falls 11℃ from crude oil solidifying point 25℃, Jingjiaping adding depressant crude oil entering oil station solidifying point is 16℃,it falls 9℃ from crude oil solidifying point 25℃.

(2)The laboratory experimental results show after An Yong oil pipeline adds the GY-3 decoagulant crude oil flow improver, crude oil solidifying point significantly falls a big margin at laboratory. From table 1 showing, Zhongshanchuan 1# oil tank adding depressant crude oil outbound solidifying point is 15℃, it falls 8℃ from crude oil solidifying point 23℃, Jingjiaping adding depressant crude oil entering oil station solidifying point is 16℃,it falls 7℃ from crude oil solidifying point 23℃;Zhongshanchuan 2# oil tank adding depressant crude oil outbound solidifying point is 16℃,it falls 9℃ from crude oil solidifying point 25℃, Jingjiaping adding depressant crude oil entering oil station solidifying point is 17℃,it falls 8℃ from crude oil solidifying point 25℃.

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Table 1 Pour Point Test Data Sheet (Adding BEM-W decoagulant)

Oil Name	**Zhongshanchuan crude oil solidifying point**	**Jingjiaping crude oil solidifying point**	**Zhongshanchuan crude oil solidifying point**	**Jingjiaping crude oil solidifying point**
Oil tank	1# Oil tank	From 1# Oil tank	2# Oil tank	From 2# Oil tank
Blank oil	23℃	23℃	25℃	25℃
Adding depressant crude oil	13℃	14℃	14℃	16℃
Falling margin	10℃	9℃	11℃	9℃

Table 2 Pour Point Test Data Sheet (Adding GY-3 decoagulant)

Oil Name	**Zhongshanchuan crude oil solidifying point**	**Jingjiaping crude oil solidifying point**	**Zhongshanchuan crude oil solidifying point**	**Jingjiaping crude oil solidifying point**
Oil tank	1# Oil tank	From 1# Oil tank	2# Oil tank	From 2# Oil tank
Blank oil	23℃	23℃	25℃	25℃
Adding depressant crude oil	15℃	16℃	16℃	17℃
Falling margin	8℃	7℃	9℃	8℃

(3)The laboratory experimental results show after An Yong oil pipeline adds the EVA decoagulant crude oil flow improver, crude oil solidifying point significantly falls a big margin at laboratory. From table 1 showing, Zhongshanchuan 1# oil tank adding depressant crude oil outbound solidifying point is 17℃,it falls 6℃ from crude oil solidifying point 23℃, Jingjiaping adding depressant crude oil entering oil station solidifying point is 16℃,it falls 7℃ from crude oil solidifying point 23℃;Zhongshanchuan 2# oil tank adding depressant crude oil outbound solidifying point is 16℃,it falls 9℃ from crude oil solidifying point 25℃, Jingjiaping adding depressant crude oil entering oil station solidifying point is 18℃,it falls 7℃ from crude oil solidifying point 25℃.

Table 3 Pour Point Test Data Sheet (Adding EVA decoagulant)

Oil Name	**Zhongshanchuan crude oil solidifying point**	**Jingjiaping crude oil solidifying point**	**Zhongshanchuan crude oil solidifying point**	**Jingjiaping crude oil solidifying point**
Oil tank	1# Oil tank	From 1# Oil tank	2# Oil tank	From 2# Oil tank
Blank oil	23℃	23℃	25℃	25℃
Adding depressant crude oil	17℃	16℃	16℃	18℃
Falling margin	6℃	7℃	9℃	7℃

3.3 Field test

The field test mainly states six aspects, including dispensing method, method of filling depressant, calculation of additive concentration, Sampling requirements, test methods, experimental results.

3.3.1 Dispensing method

To join the approximately 375 L crude oil in the 0.5m^3 ingredient cauldron, to heat up to 80~ 85 ℃ about, to join 25 kg crude oil fluid modifying addition, to dissolve for 4 hours,to match 6.25% (m/v) density solution to spare.

3.3.2 Method of filling depressant

In the batching kettle temperature being not lower than 50℃ circumstances, to have matched the good crude oil fluid modifying addition solution to continuously pour into metering pump's entrance,

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whose concentration is about 45mg/kg.

3.3.3 Calculation of additive concentration

By oil capacity 1120 t / d, 12 hour plus 25 kg agent, additive concentration:

$$\frac{25}{1120 \div 2 \times 10^3} \times 10^6 = 45 \text{ mg /kg}$$

3.3.4 Sampling requirements

To ensure outbound oil temperature 60 ℃ ~ 75 ℃;Sampling stations should take gate or ball valve sample to avoid shear to caused inaccurate data;

To first let go of dead oil,to try to avoid oil sampling to be subjected to high shear, to take heat preservation to sample to ensure accurate sampling;To record the sampling conditions, including sampling time, location, temperature, pressure and other parameters (Q/320307EAB01-2010,2010).

3.3.5 Field test methods

Determination of oil pour point blank by the national standard to carry out, determination of adding depressant crude oil solidifying point referencing Xuzhou Jinqiao petrochemical pipeline technology company limited business standard to carry out, by direct cooling.

3.3.6 Field experimental results

Field experiments show after An Yong oil pipeline adds the BEM-W decoagulant crude oil flow improver, crude oil solidifying point significantly falls a big margin. From table 2 showing, Zhongshanchuan 1# oil tank adding depressant crude oil outbound solidifying point is 11℃,it falls 12℃ from crude oil solidifying point 23℃, Jingjiaping adding depressant crude oil entering oil station solidifying point is 12℃,it falls 11℃ from crude oil solidifying point 23℃; Zhongshanchuan 2# oil tank adding depressant crude oil outbound solidifying point is 12℃,it falls 13℃ from crude oil solidifying point 25℃, Jingjiaping adding depressant crude oil entering oil station solidifying point is 13℃,it falls 12℃ from crude oil solidifying point 25℃ .

Table 4 Pour Point Field Test Data Sheet (Adding BEM-W decoagulant)

Oil Name	**Sampling Time**	**Sampling Locations**	**Sample Pressure**	**Sample Temperature**	**Solidifying Point**	**Freezing Point drop**
Zhongshanchuan crude oil	9.16.15:00	1# Oil tank	-	-	23℃	-
Zhongshanchuan adding depressant crude oil	9.16.15:45	Outbound	4.43 MPa	68℃	11℃	12℃
Jingjiaping adding depressant crude oil	9.16.17:00	Entering oil station(Oil is not to vote)	2.21 MPa	45℃	12℃	11℃
Zhongshanchuan crude oil	9.17.10:40	2# Oil tank	-	-	25℃	-
Zhongshanchuan adding depressant crude oil	9.17.12:55	Outbound	4.45MPa	67.5℃	12℃	13℃
Jingjiaping adding depressant crude oil	9.17.18:20	Entering oil station(Oil is not to vote)	2.22 MPa	43℃	13℃	12℃

4. Conclusion

(1) Laboratory experiments in Table1, Table2 and Table3 show three kinds of experimental results, among them, the best condensation effect is BEM-W decoagulant,it can cause the crude oil solidifying point of Zhongshanchuan crude oil to fall 9℃-11℃.So BEM-W decoagulant is selected to use field experiments.

(2) Laboratory test and field experiment in Table 1 and Table 4 show after An Yong oil pipeline

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adds the BEM-W decoagulant crude oil flow improver, crude oil solidifying point significantly falls a big margin both at laboratory and in the field experiment; The two experimental results are very ,crude oil solidifying point falls about 10℃ above,which can improve pipeline safety factor.Therefore,in winter, snow, rainy season and other circumstances An Yong oil pipeline had better to use the BEM-W decoagulant crude oil flow improver to eliminate the condensate tube risk when An Yong oil pipeline is running in the low throughput.

(3) The effect of pour point depressant is different between laboratory test and field test, and there are some deviations.People should take the effect of pour point depressant of the field test as standard.

(4) In fact, the subject is also a complex technical problem of drag reduction, pour point reduction, anti-wear and lubrication on long-distance crude oil pipeline, researching it is very difficult.

5. Conclusion

It is complex,urgent and challenging for Zhongshanchuan-Jingjiaping segment of An Yong oil pipeline to research the technology of preventing solidification pipe and safe and economic operation under different throughput and in different seasons.In addition,with the exploitation and utilization of crude oil at home and abroad, the world crude oil quantity will decrease year by year,and the crude oil pipeline transportation quantity will also decrease year by year,so the crude oil pipeline faces the low transportation quantity problem to become the universal reality, and the pipeline condensation risk increases year by year,too.Therefore the research on this technology is especially important, necessary, meaningful and desirable.

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