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FOR THE FUTURE GENERATION

Oil Purification System

DONGWOO E&E

CONTENTS

Eco-Friendly

To be The First Partner
Imagine Your Tomorrow

푸른 환경 없이 푸른 미래도 없습니다.
동우이엔이의 환경친화적 제품은 사람과 자연을 먼저 생각하며
모두가 행복하고 풍요로운 삶으로 이끕니다.

동우이엔이는 자연을 가장 소중히 생각합니다.
맑고 깨끗한 자연에서 세상을 움직이는 커다란 에너지가 나옵니다.
동우이엔이는 지속가능경영의 일환으로 오일정화장치를 독자기술로 개발하여
국립기술, 품질원으로 부터 우수품질을 인정 받았으며
앞선기술, 좋은 제품으로 세상을 풍요롭게, 인류의 행복을 지켜가고자
끊임없는 도전으로 신재생에너지 개발을 통해 미래 성장 동력을
확보해 나가고 있습니다.

앞선 기술, 좋은 제품으로 세상을 풍요롭게 하는 일, 이제 그 보다 더 큰 꿈을 생각합니다.

최근 점점 심각해지는 지구온난화로 인하여, 에너지 자원을 효율적으로 사용관리하기 위한 제품 개발의 필요성이 더욱 증대되고 있습니다.
2010년 세계환경시장의 규모가 8,850억달러에 이를 것으로 전망되고 있으며 특히 수자원이용, 자원재생 및 환경에너지 자원 등
환경자원 이용업 분야의 규모는 2,600억달러로 추정되고 있습니다.
2005년도 OECD 보고서 "Waste Prevention and Recycling"에 의하면 2002년도 전 세계 윤활유 사용량은 35.67천톤 정도이며 이중 약 40% 정도가
사용 후 회수되어 정상처리되는 것으로 보고되고 있어 회수되지 않은 오일로 인한 심각한 환경오염이 우려되는 것으로 보고되고 있습니다.
이에 국내외 많은 기업들이 산업용오일의 성상유지 및 수명연장을 위한 장비를 개발하여 관련 시장에서 치열한 경쟁을 하고 있습니다.
환경설비 전문제조업체인 당사의 오일정화시스템은 기존의 일반적인 처리 기술을 획기적으로 개선시켜 오일 속의 주 오염원인 수분과
입자제거 능력에 있어서 세계 최고의 성능을 자랑하고 있습니다.
이러한 성능은 국내보다는 오히려 독일의 관련제품생산으로 유명한 Hydac사를 통하여 2008년 7월에 이미 입증된 바 있습니다.
앞으로도 저희는 환경과 인간존중의 기본경영방침 아래, 고객에게는 감동의 차원을 넘 경영환경개선에 기여할 수 있는 제품을 지속적으로 개발하고
이를 전 세계에 보급하여 21세기 환경과 에너지분야의 글로벌 선도 기업이 되기 위해 전 임직원이 최선을 다하여 부단히 노력할 것을 약속드립니다.

동우이엔이(주) 대표이사 김평중

고객과 함께 21년, 그 도전과 개척의 발자취

1989. 03 : Establishment of Dongwoo Electric Company
2007. 11 : Establishment of energy and environment division in Dongwoo Electric Company
11 : Contract with Oman Shanfari Group for the exclusive sales distributionship in GCC countries
2008. 01 : Development of prototype of oil purification system
02 : Establishment of independent Dongwoo E&E Corp. for oil recycling system
: Certification of ISO 9001:2000 "Quality Management System" for oil recycling system
: Certification of ISO 14001:2004 "Environmental Management System" for oil recycling system
03 : Certification of CE "Oil Recycle System"
: Took part in International Resources · Recycling exhibition in KINTEX Korea (Supported by Kyunggi-do Government)
: Contract with German Schuler consulting company for exclusive sales distribution in Europe countries
04 : Took part in Power-Gen EUROPE 2008 exhibition in Milano Italy (Supported by Korea Western Power Company)
06 : Registration of Korea patent No. "10-0837093", "Oil Recycling System and its Method"
07 : Increase of capital to 1 million USD (Dongwoo Electric Co. has 70% of stock)
: Establishment of Dongwoo E&E research laboratory, No. "2008150173", approved by Korea Industrial Technology Association
: Performance test in Germany for dewatering and particle removal of lubrication oil and contract with a German company for confidentiality agreement
: Performance test with Shanfari Group in Oman for Oman Refinary Company
08 : Value management awards, "Environment Safety Health", by Korean government of Public Procurement Service
09 : Certification of "venture business", 20080203007, by Korean government of KIBO Technology Fund
: Took part in International Factory Automation System Show in KINTEX Korea (Supported by Korea Western Power Company)
10 : Establishment of Dongwoo E&E research institute, No. "2008110634", approved by Korea Industrial Technology Association
: Took part in Seoul International Electric Fair exhibition in KINTEX Korea (Supported by Government Fund)
11 : Excellent performance certification of oil recycling system, No. "15-434", by Korean Government of Small and Medium Business Administration
: Contract with Japan Fukuda Co. for the exclusive OEM sales distributionship in Japan, minimum 200 systems per year

Oil Purification System_Features

자연을 닮은제품, 동우오일정화장치는 사람과 자연을 먼저 생각합니다.
새로운기술과 환경을 생각하는 서비스로 신뢰를 만들어 갑니다.

Environment & Reliability

Introduction

Dongwoo's oil purification system is for the degraded or exhausted industrial oil with the water evaporation principle in vacuum chamber and the electrostatic ionization principle in the high voltage electric field. This product is helpful to prevent environmental contamination from disposal of waste oil, also to extend the life of oil. As a result, it is very economical and useful for the facilities' operation and maintenance.

Features

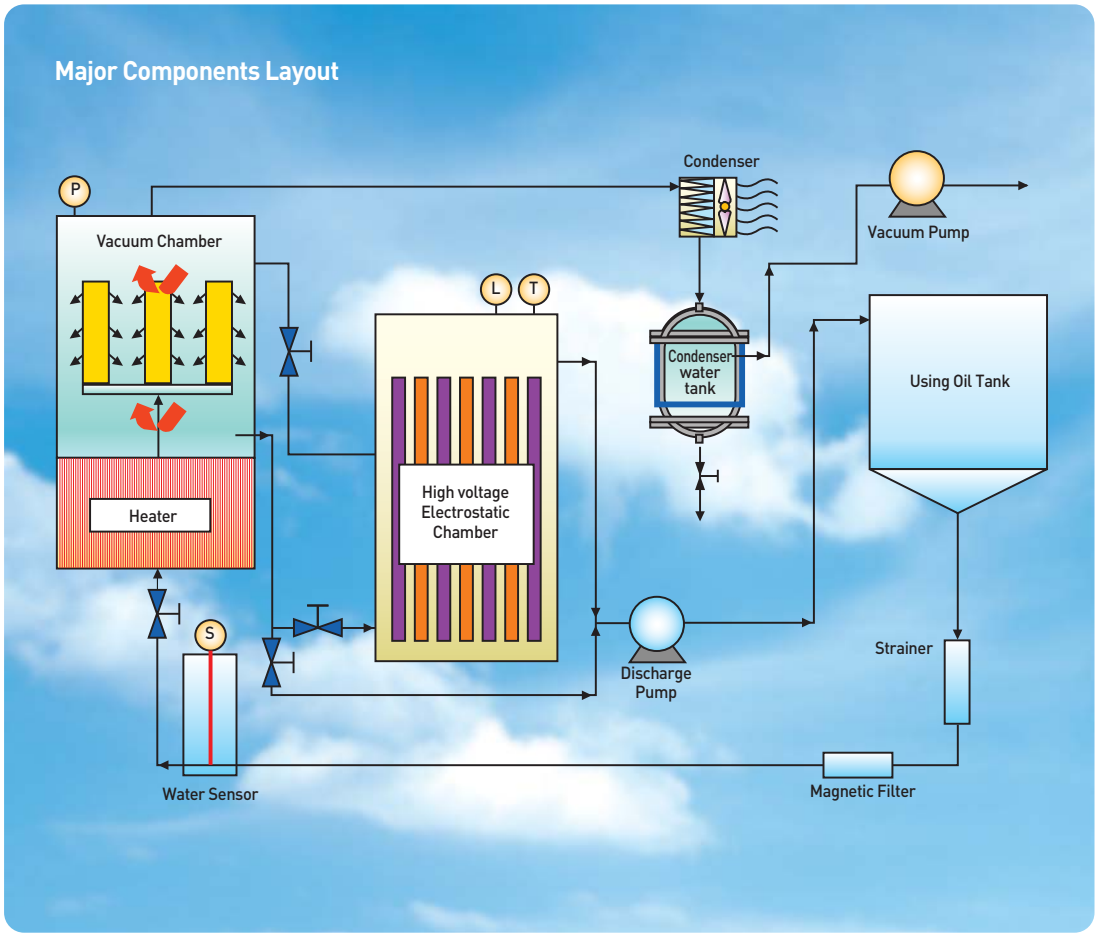
- When the degraded oil is sprayed out into the vacuum chamber through rotary nozzles, water in oil is boiled and evaporated out at lower temperature range of 40~70°C. This process shows a great effectiveness in that 100% of emulsified water and dissolved gas and 90% of dissolved water in oil can be removed.
- The spray nozzles are rotating itself and the tray of the nozzles is rotating once more so that it shows more vaporization capability of water in oil than the other products in the world market by two or more times order.
- Small particles less than one micrometer size (sub-micrometer, D $<10^{-6}$) can be eliminated by the electrostatic ionization collection principle.
- Remote control and operation are applicable to oil purification system in accordance with a customer order basis. (Optional)
- Oil temperature, the degree of vacuum and electrostatic chamber's current are the main factors showing the operation condition, and it can be remotely controlled.
- If there is any abnormal condition, you can diagnose the system at a remote location.

Specification and Capability

Items		Model No.		
		DW-1000	DW-3000	DW-5000
Specification	Related Voltage (V)	220/380/440, 3Ø, 50/60Hz		
	Compressed Air (kg/cm²)	Over 5.0 (Supplied by user)		
	Consumption Power (kw) (MAX.)	20	50	50
	Heater Capacity (Kw)	15	45	45
	Oil Viscosity (cst.) (MAX.)	460		
Capability	Ambient Temperature (°C)	-25 ~ +50		
	Degree of Vacuum (Kpa)	-72 ~ -98		
	Operation Noise (db)	Lass than 60		
	Heating Temp. (°C)	20 ~ 80		
	Flow Rate (ℓ /hr)	1,000	3,000	5,000
	Applicable Capacity (ℓ) (If working space available)	Less than 24,000	Less than 72,000	Less than 120,000
	Oil Spraying Method to Vacuum Chamber	Multiple Rotary Nozzles		
	Water Removal Method	Vacuum		
	Particles Removal Method	Electrostatic Ionization Capture		
	Dimensions	1,260(W) 1,310(L) 1,740(H)	1,470(W) 1,470(L) 1,950(H)	1,650(W) 1,490(L) 2,115(H)
	Test Oil Volume (ℓ) (Hydraulic Oil)	300		
	Operating Temperature (°C)	60 ±5		
	Operating Time (Hr)	4	2	1
	Cleanness Degree NAS (ISO)	11 grade(22/20/17) → Less than 6 grade (17/15/12)		
	Water (ppm(%))	3,000 (0.3) → Less than 300 (0.03)		

Oil Purification System_Features

System diagram



Operation Mechanism

Water and gas evaporation by high vacuum

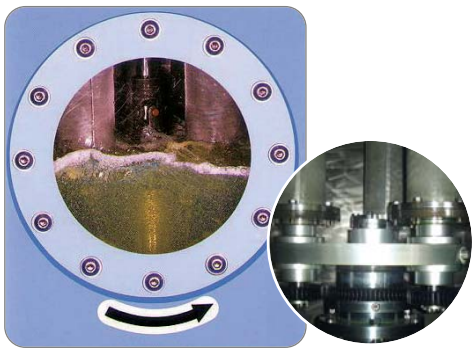
The boiling temperature in the atmospheric pressure is 100°C.
However in the higher degree of the vacuum, the boiling temperature goes down as shown in the table.
Generally oil is heated up for water and gas evaporation from oil with vacuum.
The efficiency of water and gas removal from oil depends on the oil temperature and vacuum level.
Dongwoo's system can be operated at 20~80°C with the vacuum range of -70Kpa ~ -98Kpa so that the efficiency of water and gas removal is the most in the world market.

Degree of the Vacuum [Torr. (Kpa)]	Boiling Point (℃)
720(0)	100
100(-87,9)	52
50(-94.6)	39
20(-98.6)	24

Operation Mechanism

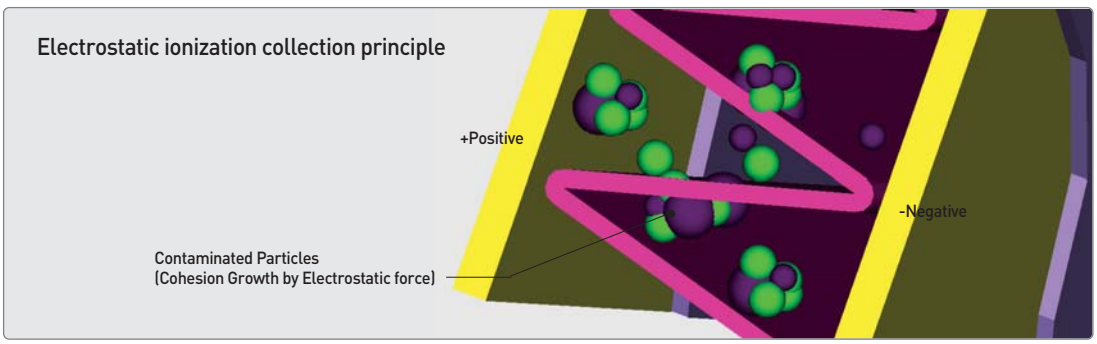
The Most Evaporation Efficiency by Rotating Spray Nozzle

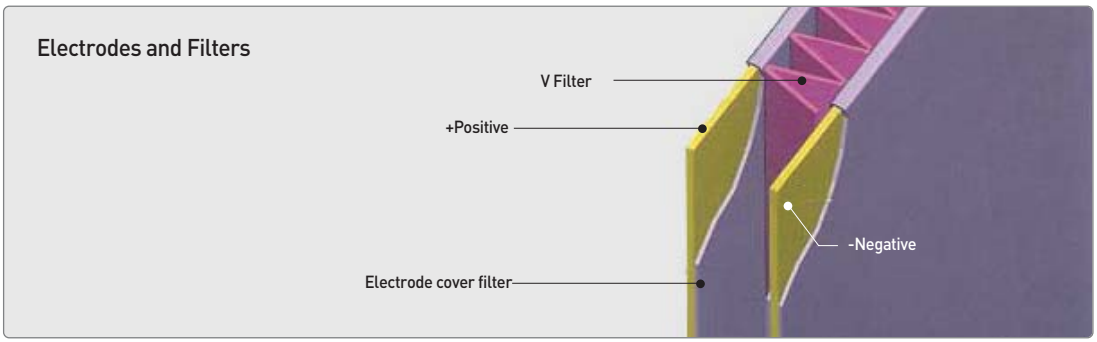
The oil contaminated by water or gas is sprayed out into the vacuum chamber through the rotating nozzles which helps to increase the specific volume and surface area of each oil droplets.
Also those nozzles itself agitate the oil so that it accelerate the evaporation of water and gas from oil. Therefore it has the most efficiency in ever exist world market.



Particle Removal using Electrostatic Ionization

The electrostatic ionization principle is that when high voltage is loaded into positive and negative electrode plates, electric field is formed between two electrodes and then contaminated neutral particles are changed into electrically ionized and charged particles.
The contaminated particles which have electric charges are extracted from oil and captured within the filters in front of electrodes because of the electrostatic force (Coulomb's force). In the electric field, contaminated small particles are getting together because of electrical attraction force and gradient force. Those small contaminated particles are growing to the movable critical size in the electrical field.
And then the particles move toward the electrodes overcoming fluid frictional resistance.
As a result, the small particles below the micrometer size(D $<10^{-6}$) are able to be removed within the electrostatic fields.





Oil Purification System_Features

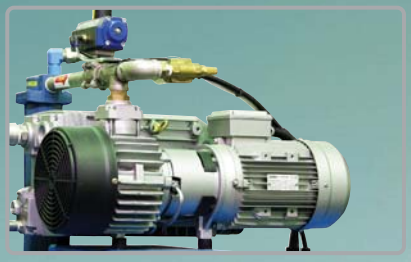
Main Components of System

System Operation

Operation Panel

It has a touch screen for easy operation. Operator can select operation modes and set the operation parameters. It can be monitored and operated at remote location by internet in accordance with a customer's order. (Optional)

- Oil temperature, the degree of vacuum and electrostatic chamber's current are the main factors showing the operation condition, and it can be remotely controlled.
- If there is any abnormal condition, you can diagnose the system at a remote location.



1 Vacuum Pump

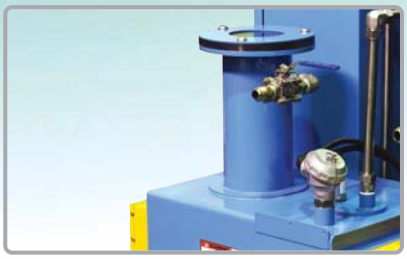
Vacuum pump is the main power source for the suction and circulation of oil within the system. The vacuum degree ranges up to 80 Torr. and a moisture separator is installed before the vacuum pump to protect the vacuum pump from water and to maximize the vacuum power.

2 Vacuum Chamber

The heated oil is sprayed out into vacuum chamber through multi rotating spray nozzles and this way helps to increase the specific volume and surface area of oil. It accelerate the evaporation of the water from oil efficiently. The evaporated water is condensed through fan cooler and then the condensed water are able to be drained out.

3 Main Operation Panel

It is main operation and control panel for setting of oil temperature, electric current limit of high voltage chamber, and the interval of filter replacement. Also it displays parameters such as electric current value, oil temperature, operation time, alarm and its measures, etc.

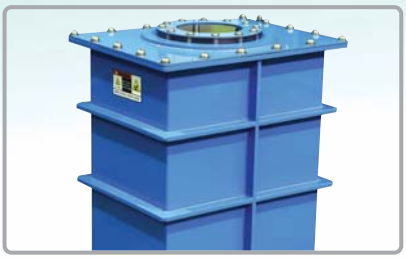


4 Mechanical Pre-Filter

When the oil is coming into the system, at first impurity particles over 5㎛ size within the oil are easily filtered out mechanically through the pre-filter. The filtering power can be selected according to oil conditions and operator's engineering judgment.

5 Humidity and Temperature Sensor

When the oil is coming into the system the humidity and temperature of oil is measured by this sensor. If oil contains water more than set value, oil do not come into the high voltage ionization chamber until the humidity goes down to the set value for more effective particles removal with the high voltage at lower humidity.

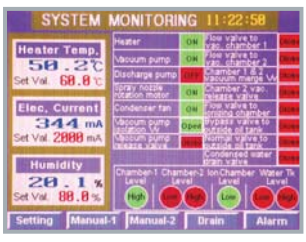


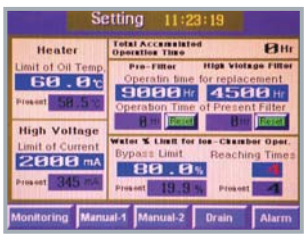
6 High Voltage Ionization Capturer

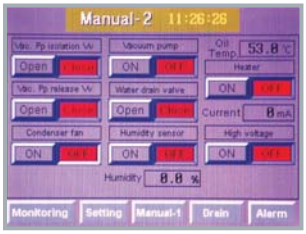
When high voltage is loaded into electrode plates inside of the chamber, electric field is formed between electrodes and impurity particles within the oil are electrically changed into charged particles (Ionization). The charged small particles are getting together cohesively in the electrical field and then the particles move toward the each positive or negative electrode. Finally the particles are extracted from oil and captured within the filters installed between electrode plates. Therefore the small particles less than 1㎛ size are able to be removed effectively.

1	2	3
4	5	6

1. Monitoring Screen
2. Setting Screen
3. Manual-1 Screen
4. Manual-2 Screen
5. Draining Screen
6. Alarm Screen







Technology Development Efforts

Laboratory Test Results

■ Hydraulic Pressure Oil (Jan. 9th, 2008)

Test Conditions and Results	
Ambient Temperature (℃)	10
Operating Temperature (℃)	70±5
Working Hours (Hr)	2
Volume of Oil (ℓ)	250
Cleanness Degree NAS(ISO)	11grade(22/20/17) → Under 6grade (17/15/12)
Water in Oil [ppm(%)]	1.520 → 193

Field Test Results

■ Transformer Oil (Feb. 21th, 2008)

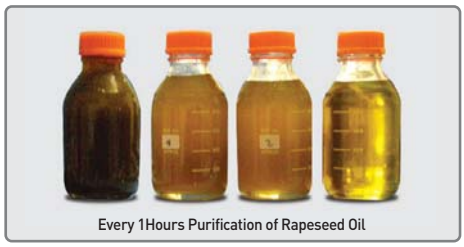
Parameters	Unit	Results and Criteria		
		Before	After (4Hours)	Criteria
Particle(NAS)	Class	Over 12	6	-
Water	mg/kg(ppm)	5,549	60	Less than 50
Total Acid Number	mg KOH/g	0.62	0.12	Less than 0.2
Breakdown Voltage (2.5mm)	kV	not testable	67,000	Greater than 30,000

■ Transformer Oil (Feb. 27th, 2008)

Test Conditions and Results	
Ambient Temperature (℃)	12
Operating Temperature (℃)	60±5
Operating Time (Hr)	3
Purified Oil (ℓ)	1,200
Breakdown Voltage (V)	25,000 → 67,000

Abroad Countries Test Results

Bio Oil (Apr. 1th, 2008 in Germany, Rapeseed Oil)

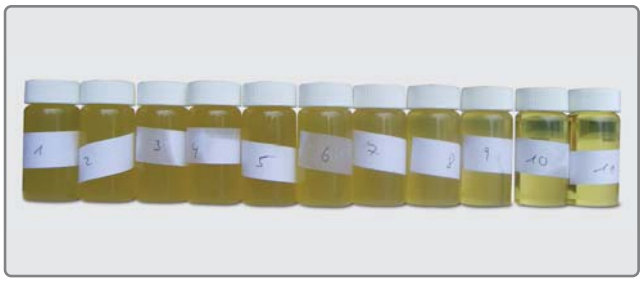


Every 1Hours Purification of Rapeseed Oil

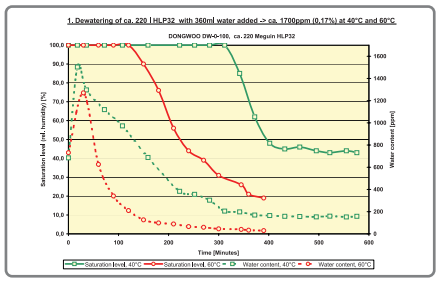
Parameters	Unit	Results and Criteria		
		Before	After (4Hours)	Criteria
Phosphour Lipd	mg/kg(ppm)	737	102	-
Phosphorus	mg/kg(ppm)	29	4	12

- Rapeseed oil is used as combustion fuel in small combined power plant in Germany
- Phosphorus and phosphour lipd are very important parameters for the integrity of facilities, and emission gas control by the German government for the clean environment

Water Removal Test Results in Germany



Every 10 minutes purification of 200 liters hydraulic oil



Converted results from 200 liters to 600 liters oil

Ingredient Analysis Results in Germany

SPECTRO X-LabPro — Auftragsnummer: 2008_W29

Vorgegebene Probendaten

Probenname	**HLP 32 a. Fass**	Verdünnungsmaterial	
Beschreibung		Probenmasse (g)	4,0075
Methode	Additive in Oil_1	Verdünnermasse (g)	0,0000
Auftragsnummer	2008_W29	Verdünnungsfaktor	1,0000
Probenart	Liquid, 24 mm	Probendrehung	Nein
Probenzustand	Liquid	Eingangsdatum	18.07.2008
Status der Probe	X A X X X X X A	Auswertungsdatum	18.07.2008

Ergebnisse

Der angegebene Fehler ist der statistische Fehler mit 1 sigma Vertrauensbereich.

Z	Symbol	Element	Konzentration		Abs. Fehler	
12	Mg	Magnesium	< 9,1	mg/kg	(0,0)	mg/kg
14	Si	Silizium	< 1,0	mg/kg	(0,0)	mg/kg
15	P	Phosphor	47,3	mg/kg	0,8	mg/kg
16	S	Schwefel	5011	mg/kg	4	mg/kg
17	Cl	Chlor	< 0,5	mg/kg	(0,0)	mg/kg
19	K	Kalium	< 0,8	mg/kg	(0,0)	mg/kg
20	Ca	Calcium	3,1	mg/kg	0,1	mg/kg
26	Fe	Eisen	9,7	mg/kg	0,2	mg/kg
28	Ni	Nickel	< 2,0	mg/kg	(0,0)	mg/kg
29	Cu	Kupfer	< 0,6	mg/kg	(0,0)	mg/kg
30	Zn	Zink	< 0,5	mg/kg	(0,0)	mg/kg
42	Mo	Molybdän	0,9	mg/kg	0,1	mg/kg
56	Ba	Barium	< 0,8	mg/kg	(0,0)	mg/kg
82	Pb	Blei	< 0,6	mg/kg	(0,0)	mg/kg

Datum: 18.07.2008 Seite 1

Ingredient Before Purification

SPECTRO X-LabPro — Auftragsnummer: 2008_W29

Vorgegebene Probendaten

Probenname	**HLP 32 n. Filtration**	Verdünnungsmaterial	
Beschreibung		Probenmasse (g)	4,0281
Methode	Additive in Oil_1	Verdünnermasse (g)	0,0000
Auftragsnummer	2008_W29	Verdünnungsfaktor	1,0000
Probenart	Liquid, 24 mm	Probendrehung	Nein
Probenzustand	Liquid	Eingangsdatum	18.07.2008
Status der Probe	X A X X X X X A	Auswertungsdatum	18.07.2008

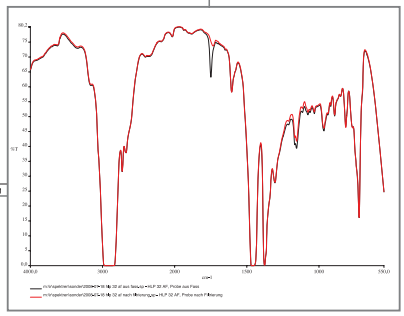
Ergebnisse

Der angegebene Fehler ist der statistische Fehler mit 1 sigma Vertrauensbereich.

Z	Symbol	Element	Konzentration		Abs. Fehler	
12	Mg	Magnesium	< 9,1	mg/kg	(0,0)	mg/kg
14	Si	Silizium	< 1,0	mg/kg	(0,0)	mg/kg
15	P	Phosphor	53,9	mg/kg	0,8	mg/kg
16	S	Schwefel	4983	mg/kg	4	mg/kg
17	Cl	Chlor	< 0,5	mg/kg	(0,0)	mg/kg
19	K	Kalium	< 0,8	mg/kg	(0,0)	mg/kg
20	Ca	Calcium	7,1	mg/kg	0,2	mg/kg
26	Fe	Eisen	7,3	mg/kg	0,2	mg/kg
28	Ni	Nickel	< 2,0	mg/kg	(0,0)	mg/kg
29	Cu	Kupfer	< 0,6	mg/kg	(0,0)	mg/kg
30	Zn	Zink	23,9	mg/kg	0,1	mg/kg
42	Mo	Molybdän	< 0,7	mg/kg	(0,0)	mg/kg
56	Ba	Barium	< 0,8	mg/kg	(0,0)	mg/kg
82	Pb	Blei	< 0,6	mg/kg	(0,0)	mg/kg

Datum: 18.07.2008 Seite 1

Ingredient After Purification



Ingredient FTIR Before and After Purification

Test Result

Application and Results

Performance test in Venezuela (7th ~ 8th APR. 2009 at Tia Juana PDVSA)

Hydraulic oil 200 liters

- Water removal : 5hours
- Particle removal : 2hours

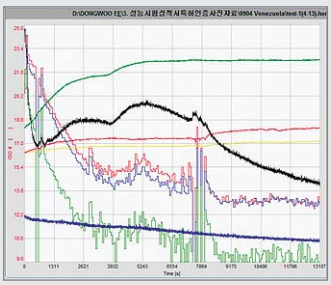
100% →20% (6hours @60℃)
20,000ppm →250ppm (?)

NAS 12 Class →7 Class (2hours)

Performance test in Venezuela (13th ~ 14th APR. 2009 at Tia Juana PDVSA)

Transformer oil 200 liters @60℃ Water & Particle Removal

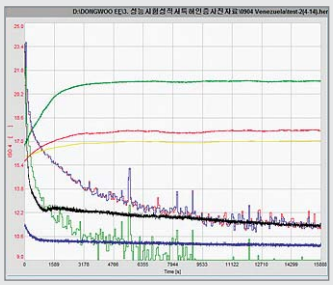
13th of April (3hours 40min)



20% →8.3% (@60℃)
300 ppm →80 ppm (?)

NAS 12 Class →3 Class

14th of April (4hours)



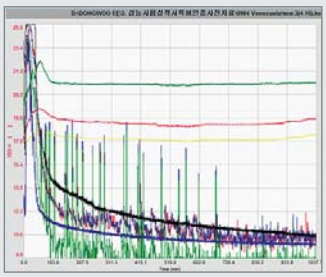
15% →6.5% (@60℃)
90 ppm →25 ppm (?)

NAS 12 Class →1 Class

Performance test in Venezuela (15th ~ 16th APR. 2009 at Maracaibo ENELVEN)

Turbine oil 200 liters @60℃ Water & Particle Removal

5 hours of total 17 hours operation



100% →10% (@60℃)
1500 ppm →30 ppm (?)

NAS 12 Class →1 Class

Performance test in Venezuela (16th APR. 2009 at Maracaibo ENELVEN for ENELCO)

10 hours

Transformer oil 200 liters
@60℃ Water & Particle Removal

100% →38% (@60℃)
150,000ppm →200ppm (?)

NAS 12 Class →1 Class

Application and Results

Performance test in Venezuela (20th ~ 21th APR. 2009 at Moron CADAFE)

Hydraulic oil 200 liters @60℃
Water & Particle Removal

	Water (%)	Particles (%)	Viscosity (cSt @40℃)	Acid (mg KOH/g)
Before	0.1	Trazas	43.8	0.56
After	ND	ND	44.0	0.50
Criteria	≤0.1	≤0.1	46.0	1.0 MAX

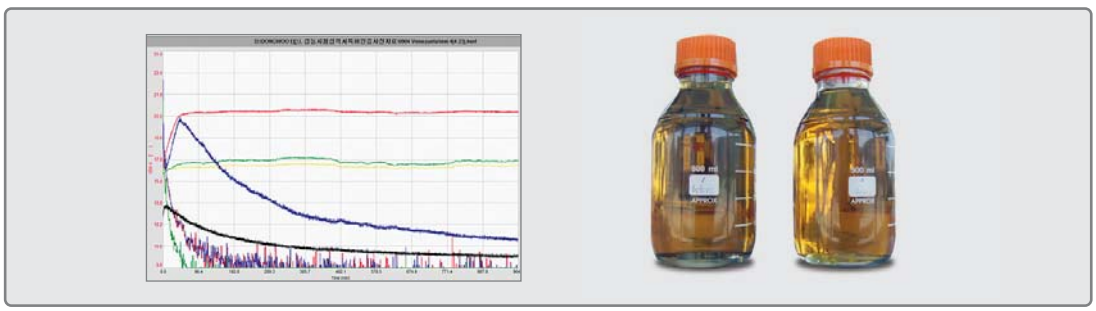
Performance test in Venezuela (21th ~ 22th APR. 2009 at Moron CADAFE)

Turbine oil #32 VOITH oil of 200 liters @60℃
Water & Particle Removal

	Water (%)	Particles (%)	Viscosity (cSt @40℃)	Acid (mg KOH/g)
Before	1.2	Trazas	32	0.1
1 hour	≤0.1%	ND	-	-
18 hours	ND	ND	31.9	0.1
Criteria	<0.1	<0.1	32 (±10%)	0.5 MAX

Performance test in Venezuela (23th APR. 2009 at Moron CADAFE)

Unit 5 20 years old 400KV transformer oil 300 liters @60℃ Water & Particle Removal



	Breakdown Voltage (kV)	Viscosity (cSt @40℃)	Acid (mg KOH/g)	Water (5 hours)	Particle (2 hours)
Before	30	11.48	0.016	60ppm (?)	NAS 8
After	31	11.31	0.0158	20ppm (?)	NAS 1
Criteria	30 ≥for 400kV	12	0.11 for 400kV		

Application in Oman

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