

KLEENTEK Electrostatic Liquid Cleaners (ELCs)

- Off-line oil cleaners
- Cleans by electrostatic attraction
- Operates whilst machine is on-line
- Removes hard and soft contaminants
- Cleans to sub-micron levels
- Removes varnishing & extends oil & component life



KLEENTEK Electrostatic Liquid Cleaners (ELCs)

“85% of all problems in hydraulic systems are caused by contaminated oil”

Fluid Power Transmission Group

Conventions dictate need for high cleanliness using ISO or NAS standards

There are many contaminants not represented by ISO or NAS standards.

What are they? Where do they come from? What do they cause? How are they detected? How they are controlled?

KLEENTEK Electrostatic Liquid Cleaners (ELCs)

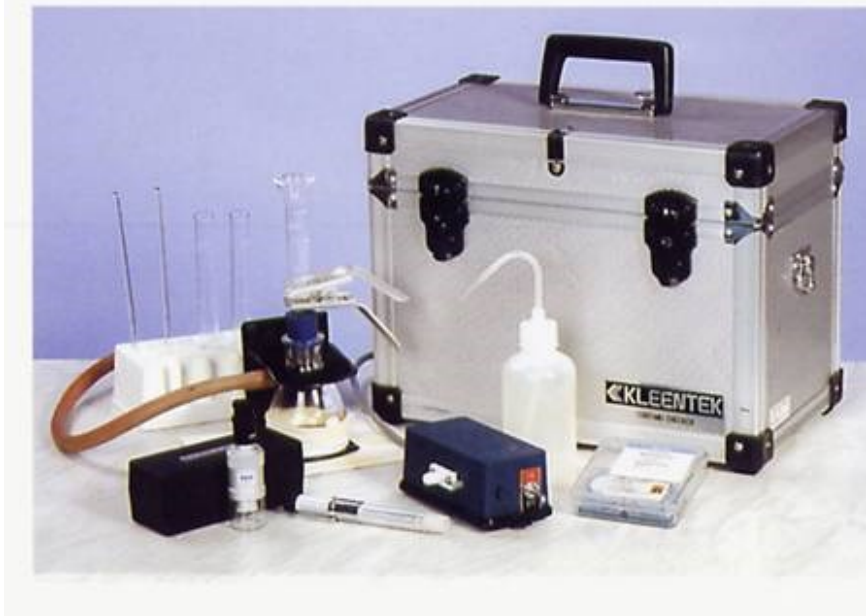
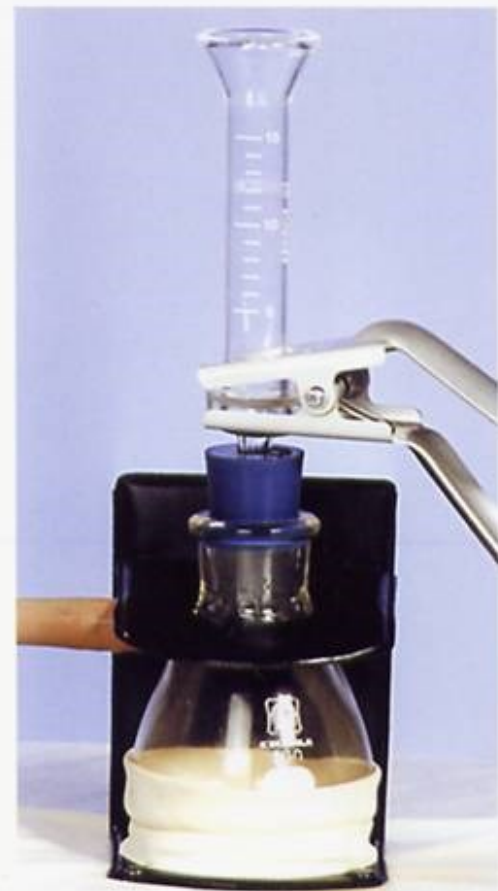
- **HARD** - *Wear metals, dust, etc.*
- **WATER** - *free or emulsified*
- **SOFT** - *Oxidation products, depleted additives*



The norm is to look at the top two
Many believe soft contaminant to be harmless – **WRONG!**

KLEENTEK Electrostatic Liquid Cleaners (ELCs)

**Identifies all insoluble
Contaminants.
Can be used on-site**

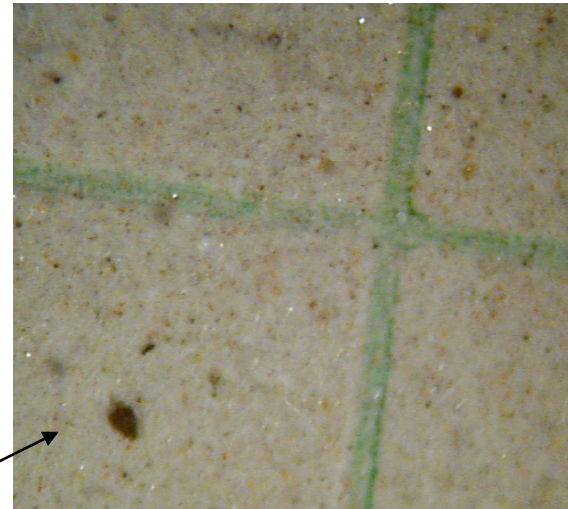


KLEENTEK Electrostatic Liquid Cleaners (ELCs)

- Measured against ISO and NAS standards, based on particle count
- Measure particles $> 5\mu\text{m}$
- Majority of particles are $< 5\mu\text{m}$
- Measurement does not show levels of soft contaminants

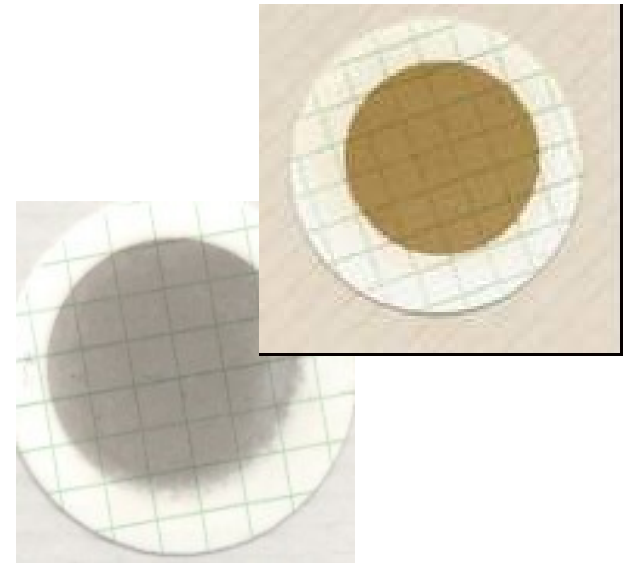
50 x magnified view of the patch

With this you can estimate
The ISO or NAS
particle count grade



KLEENTEK Electrostatic Liquid Cleaners (ELCs)

- **Include sub-micron hard particles, oxidation products & depleted additives**
- **Measured by drawing oil through .8 μm patch and view discoloration**
- **Such contaminants are not represented by ISO or NAS standards**
- **Such contaminants are mainly sub-micron, so are not removed by conventional filters**

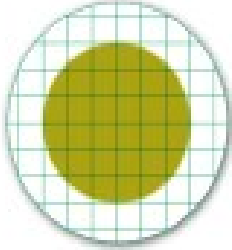
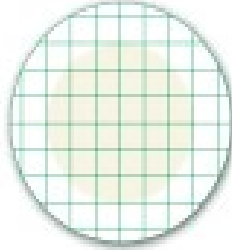


KLEENTEK Electrostatic Liquid Cleaners (ELCs)

	Sample 1	Sample 2
ISO 4406	15/12	15/12
NAS 1638	6	6

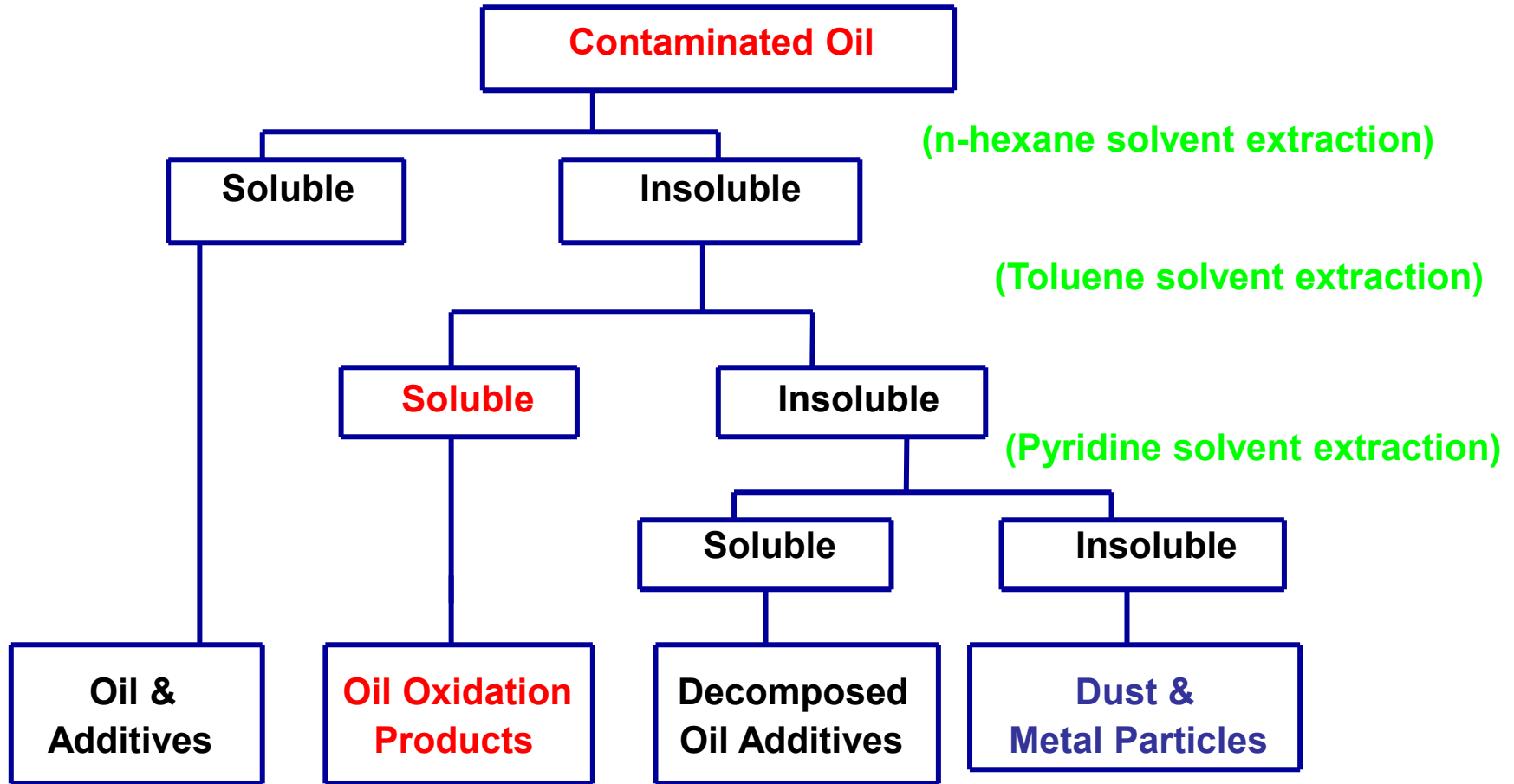
**If measuring by standard analysis – ie - ISO or NAS,
then both oil samples look the same – ie 15/12 or NAS 6**

KLEENTEK Electrostatic Liquid Cleaners (ELCs)

	Sample 1	Sample 2
ISO 4406	15/12	15/12
NAS 1638	6	6
Gravimetric Test ASTM F 313-78 0.8 micron membrane		
Contaminant level mg/100ml	6mg/100ml	<1mg/100ml

However, when considering the soft contaminants sample 1 is far dirtier – standard analysis would not detect this

KLEENTEK Electrostatic Liquid Cleaners (ELCs)



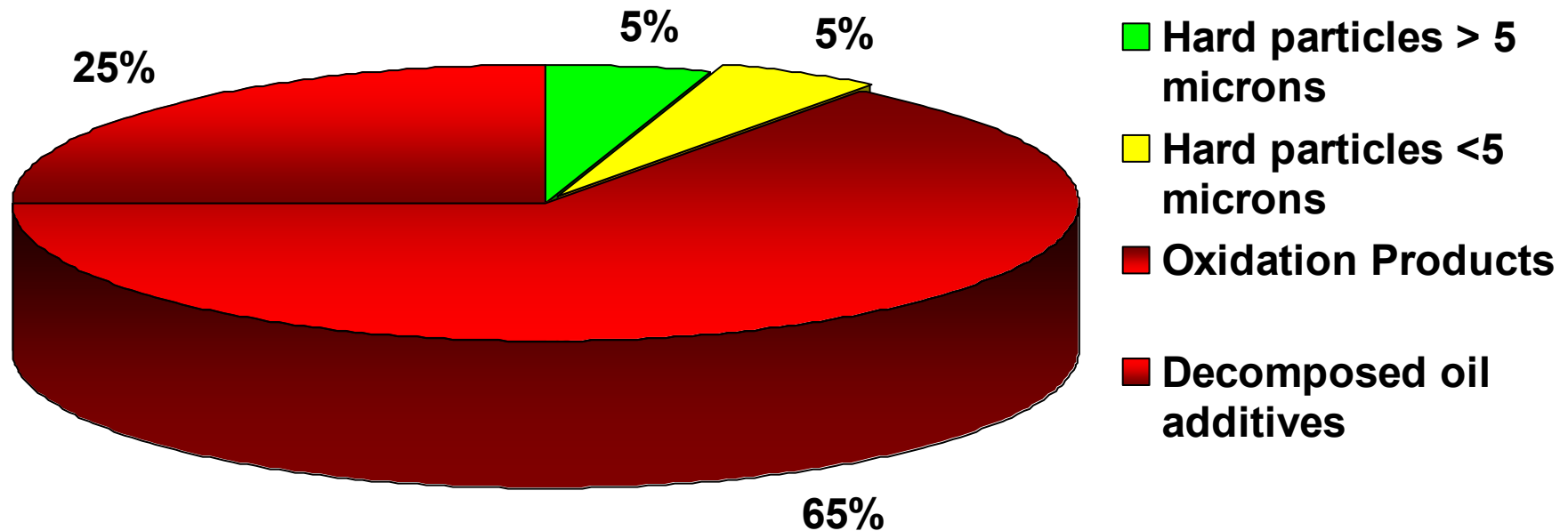
Source – Dr Akira Sasaki

KLEENTEK Electrostatic Liquid Cleaners (ELCs)

Sample #	1	2	3	4	5
Unit	mg (%)	mg (%)	mg (%)	mg (%)	mg (%)
N-hexane insoluble	15.3 (100)	13.6 (100)	84.8 (100)	37 (100)	30.1 (100)
Oil Oxidation products	7.2 (47)	9.2 (67.6)	52.8 (62.3)	25 (67.6)	22.4 (74.4)
Decomposed oil additives	6.3 (41.2)	3.6 (26.5)	25.9 (30.5)	9.7 (26.2)	6.2 (20.5)
Dust & metal particles	1.8 (11.8)	0.8 (5.9)	6.1 (7.2)	2.3 (6.2)	1.5 (5.0)
Oil age	2	3	3	3	4

Source – Dr Akira Sasaki

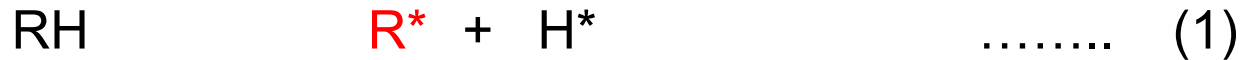
KLEENTEK Electrostatic Liquid Cleaners (ELCs)



So oxidation products are the largest group

KLEENTEK Electrostatic Liquid Cleaners (ELCs)

Initiation: (Oil Molecules must be sheared)



(Oil oxidation starts by shearing oil molecules and producing free radicals)

Propagation:



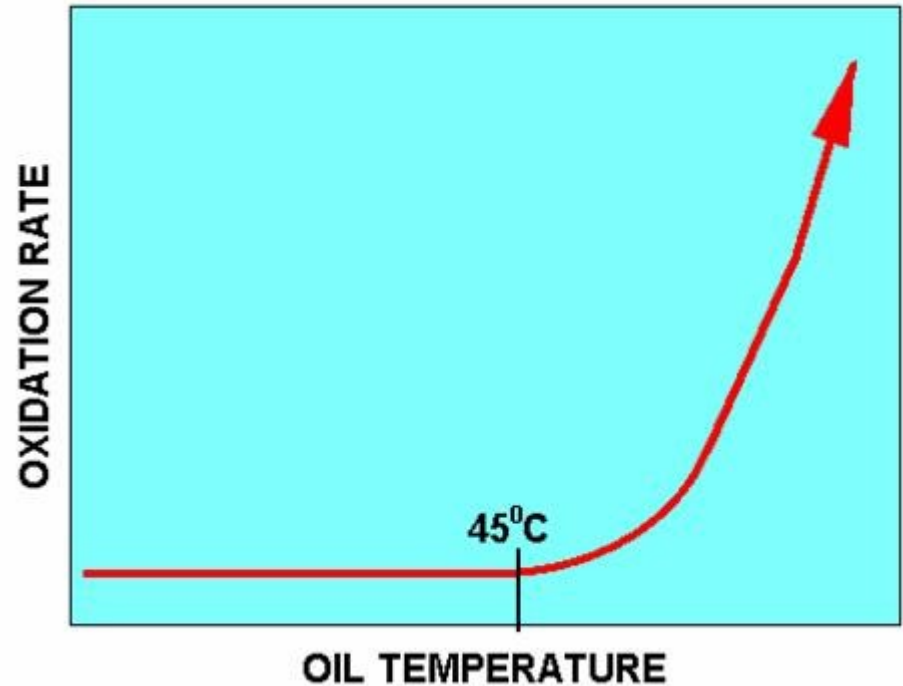
(Production of Peroxy Radicals)



(Production of Hydro-peroxide)

KLEENTEK Electrostatic Liquid Cleaners (ELCs)

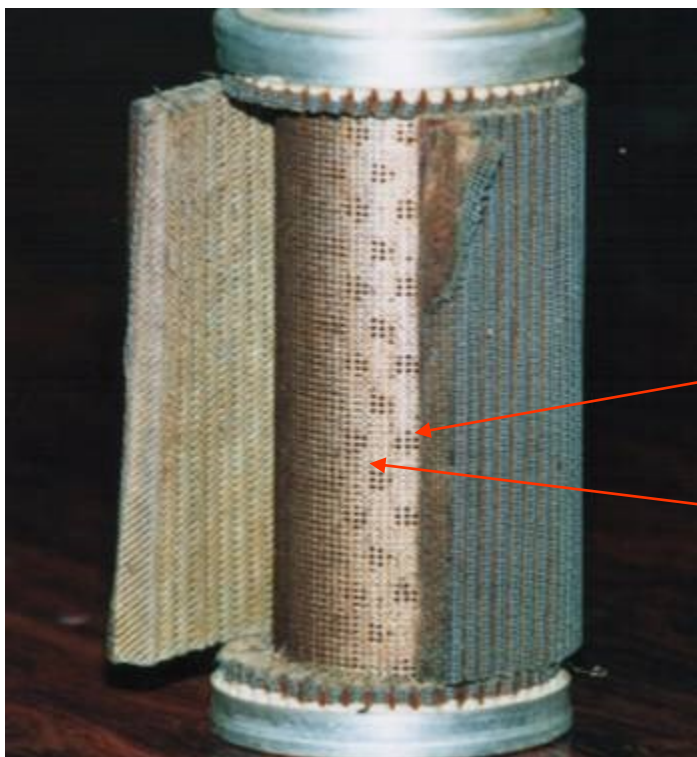
- Oxygen and oil molecules react - form new compounds
- Air dissolves in oil to around 10% volume at atmospheric pressure (Henry's Law)
- Oxidation rate doubles for every 10°C above 45°C
- Other contaminants act as catalysts



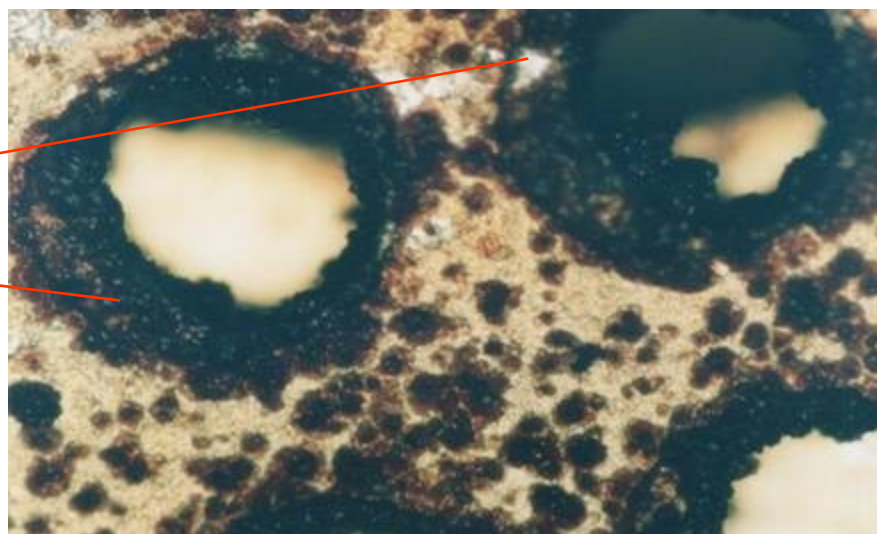
So all oil systems get it – to varying degrees

KLEENTEK Electrostatic Liquid Cleaners (ELCs)

Sparks occur between centre core and pleated edges. (In 3 months use)



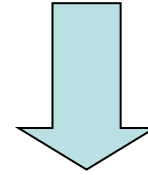
Microscopic photo of black spots



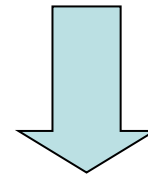
KLEENTEK Electrostatic Liquid Cleaners (ELCs)

Alcohols
Aldehydes
Ketones
Saturated esters
Lactones
Peroxides (unstable products)
Carbon monoxide
Carbon dioxide
Organic acid (TAN)
Polymerised hydrocarbons (Sludge)
Water

Initially soluble



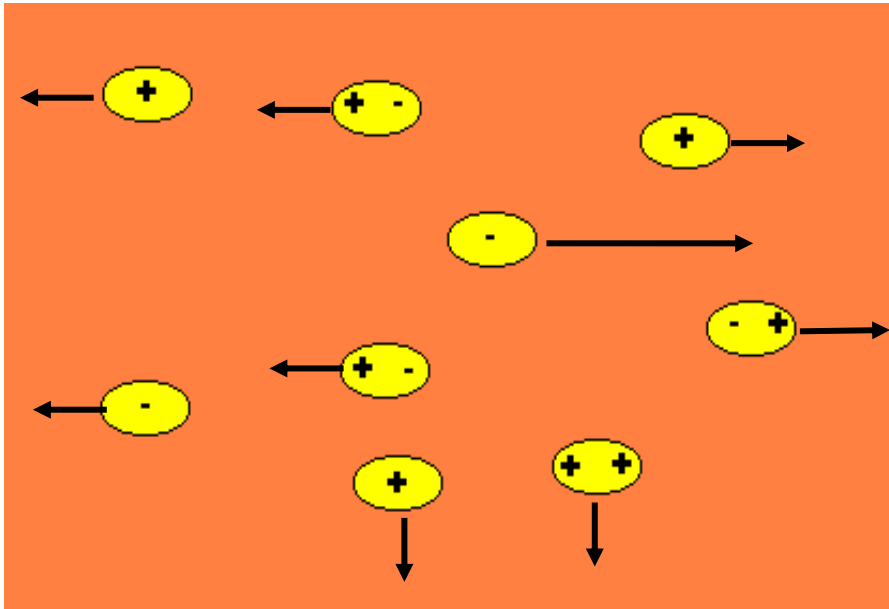
**Polymerisation &
agglomeration**



Insoluble

Act like contaminants

KLEENTEK Electrostatic Liquid Cleaners (ELCs)



- Free particles, including oxidation products, are polar
- As a result, they attach themselves to the oil system internals – including seals, bearings, valves etc

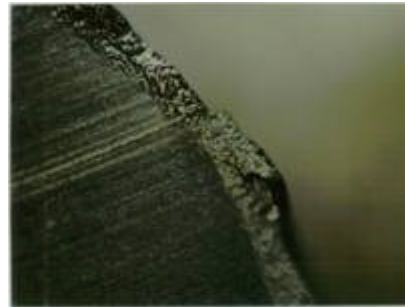
KLEENTEK Electrostatic Liquid Cleaners (ELCs)



Sticking valves



Gradually layers build up, leading to:



Seal deterioration



Filter or strainer blockage



Sandpaper effect on moving parts



Dirty maintenance environment

KLEENTEK Electrostatic Liquid Cleaners (ELCs)

- Form coatings on internal surfaces = increased friction
- Coatings lead to 'Stick- Slip' on moving parts
- Sticky coatings 'Glue' hard particles = wear
- Oxidation products attack seals = leaks
- Oxidation process depletes Anti-Oxidants = reduced oil life
- During oxidation process acidic by-products are formed
- Oxidation products encourage further break-down of the oil

KLEENTEK Electrostatic Liquid Cleaners (ELCs)

**Portable
stand alone unit**

Oil drawn from
reservoir with
integral pump

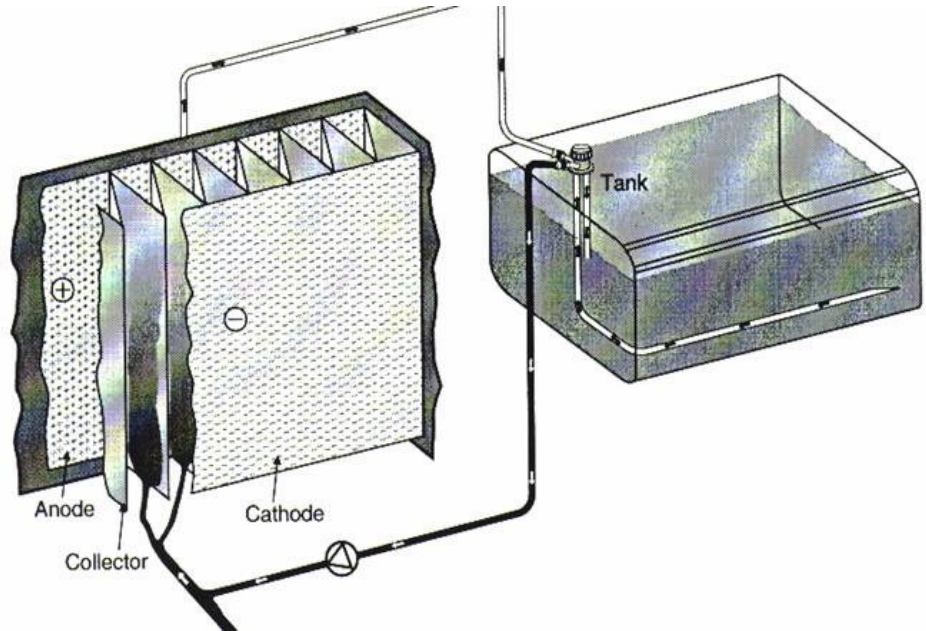


Oil is then
returned to
the reservoir

Oil is processed
in the Collector
Chamber



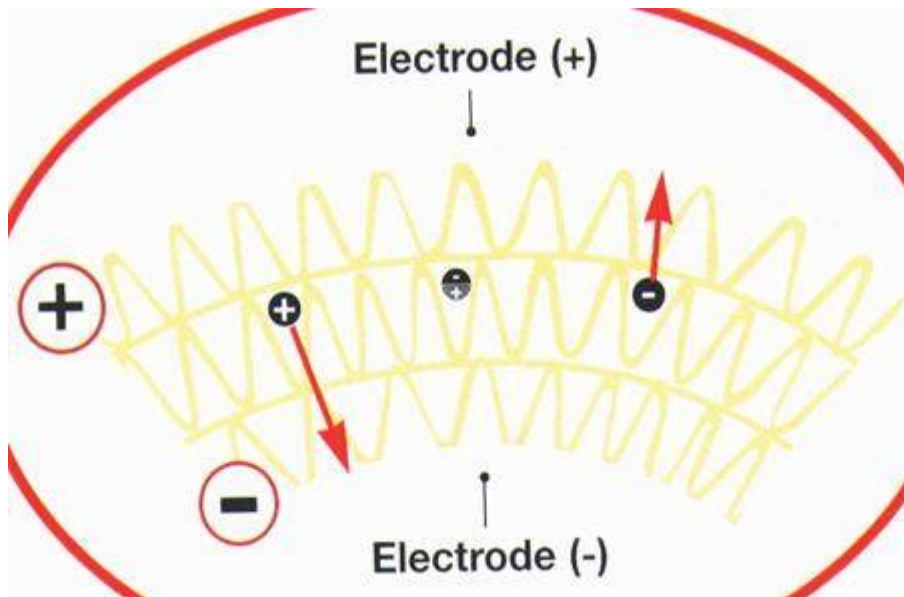
KLEENTEK Electrostatic Liquid Cleaners (ELCs)



Oil is drawn from the reservoir and passed between a series of Anodes and Cathodes

The polar contaminants are attracted out of the oil and into a Collector

KLEENTEK Electrostatic Liquid Cleaners (ELCs)



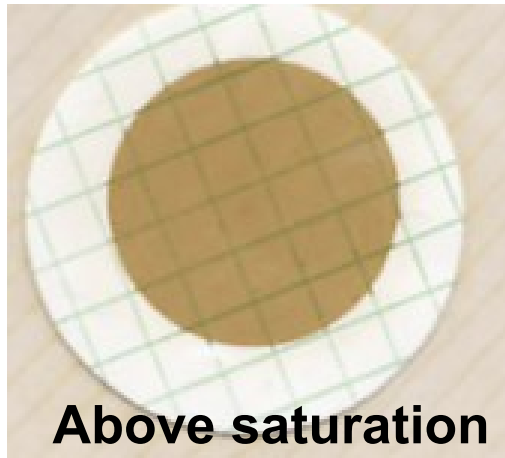
Electrophoresis & Dielectrophoresis

Polar contaminants are attracted to their opposite electrode

Neutral particles are collected as they move towards areas of high field intensity created by the Collector material

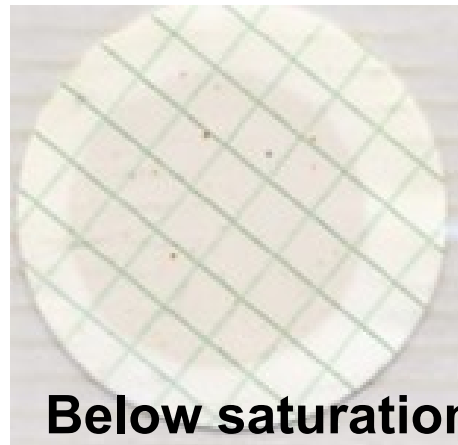
KLEENTEK Electrostatic Liquid Cleaners (ELCs)

If the discoloration is maintained at low levels this means oil is below saturation, at which point dirt is removed from internals



Above saturation

**Used oil
3µm filter
1 year old**



Below saturation

**Same used oil
Cleaned with
KLEENTEK ELC**

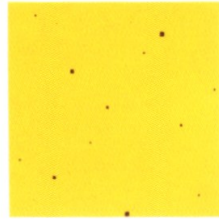


New oil

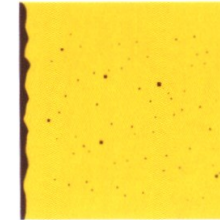
0.8µm membrane

KLEENTEK Electrostatic Liquid Cleaners (ELCs)

New system

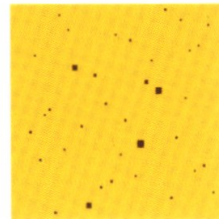


Fit ELC

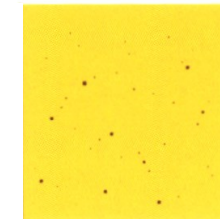


Step 1

Oil becomes saturated with polar contaminants

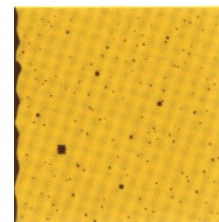


Remove contaminants from oil



Step 2

Layers develop on system Internals



Unsaturated oil removes layers from system internals



Step 3

So Kleentek cleans the system, not just the oil. But this takes time

KLEENTEK Electrostatic Liquid Cleaners (ELCs)



- **Collectors are replaced every 2000 hours**
- **This ensures cleaning efficiency is maintained**
- **Procedure takes 30 minutes**

KLEENTEK Electrostatic Liquid Cleaners (ELCs)

This example illustrates how KLEENTEK has removed deposits from the inside of the machine's pipe-work



Before applying ELC



After applying ELC

KLEENTEK Electrostatic Liquid Cleaners (ELCs)



**Main influences
are oil volume,
viscosity and
system type nature**

Type of unit	Cleaning capacity, litres Hydraulic oils, ISO VG				Dimensions (mm) l x w x h	Weight Kg
	32	46	68	100		
ELC-R3PSP	800	560	380	210	311x361x531	20
ELC-R6PSP*	1600	1120	760	420	359x386x531	23
ELC-R10SP	5000	3400	2200	1200	675x350x915	70
ELC-R25SP	12400	8600	5800	3200	675x350x950	72
ELC-R50SP	24000	16600	11200	6000	710x530x1080	108
ELC-R100SP	48000	33200	22400	12000	1070x515x1080	161

KLEENTEK Electrostatic Liquid Cleaners (ELCs)

Suitable for:

- **Hydraulic oils**
- **Circulating/lube oils**
- **Gear oils**
- **Thermal oils**
- **Compressor oils**
- **Mineral oil cutting fluids**
- **Transformer oils**

Not suitable for:

- **Water based fluids**
- **Engine oils**
- **Some synthetics**

KLEENTEK Electrostatic Liquid Cleaners (ELCs)

- Cost savings** -
 - Reduced oil changes & top-ups**
 - Reduced valve/pump/brg etc changes**
 - Reduced filter changes**
 - Reduced power consumption**
- Increased output** -
 - Increased up-time**
 - Improved cycle times**
 - Improved planned maintenance**
 - More proactive maintenance regime**
- Environment** -
 - Reduced leaks**
 - Reduced oil changes**
 - Cleaner machine internals and externals**
- Bottom line** -
 - Reduced maintenance cost**
 - Increased output**