# TORS series – Transformer Oil Regeneration System

REDRAGON

Regeneration systems typically remove the by-products of aging from used transformer oil. By-products that are known as secondary contamination are created as a result of natural aging of a transformer in service coupled with inadequate maintenance regimens. There are traditionally two approaches to the removal of these contaminants, either approach will result in the used oil being restored to 'as new'.

Comparison of Reactivation vs. Single-use Fullers Earth systems used under identical conditions

| | Reactivation | Single-use |
|---|---|---|
| Method | Process, saturate, reactivate, process, saturate, reactivate, etc | Process, saturate, dispose |
| Disposal | Regular landfill | Specialist |
| Times used | 300 - 500 | 1 |
| Oil loss | < 0.4% | > 5% |
| Amount required to process 2.5 Mlitre | 1 ton | 100 ton |
| Lifetime yield | 2500 litre/kg | 25 litre/kg |
| Change-out frequency | 4 years | 1 week |

The TORS series allows for customization of the reactivation type of regeneration system. Larger systems are ideally suited to unattended tank farm operation, where there is practically no limit to the number of columns used and hence volume processed.

*Above: TORS-6000, at underground generating station*

Mobile systems are usually limited by the prevailing road transport regulations and may limit systems to 44 ton in weight or 53-foot in length. Practically, this tends to limit the system flow rates to around 10,000 litres per hour.

*Above: TORS-6000 at sub-station*

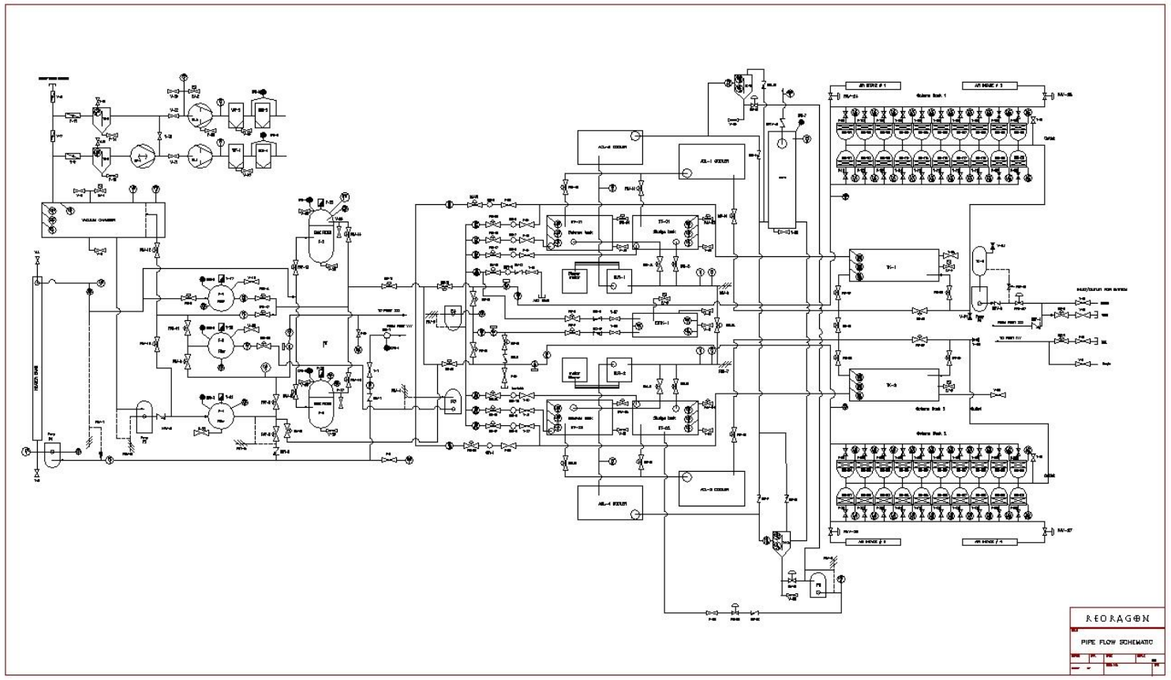
## Typical regenerated oil specification

Guaranteed parameters achieved after regeneration with TORS series

| Characteristic | Unit | After regeneration |
|---|---|---|
| Acidity | mg KOH/g oil | <0.01 |
| Appearance | | Sparkling |
| Colour | L | <0.5 |
| Corrosive sulphur | | Absent |
| Dielectric breakdown | kV | >70 |
| Gas content | % | <0.1 |
| IFT | dynes/cm | >40 |
| Moisture content | ppm | <5 |
| Oxidation - acidity | mg KOH/g oil | <0.2 |
| Oxidation - sludge | % | <0.03 |
| Particle size | µ | <2 |
| Tan delta @ 90°C | | <0.001 |

## Benefits of regenerating oil

- ***Life extension of a limited resource*** – Regeneration technology has a long history which shows that recycled oil is as good as, if not better than new. The same oil that has been aged, regenerated, aged and regenerated 6 times shows no decrease in efficiency showing an effective lifetime for oil-in-use of over 100 years.*




- ***Economically advantageous*** – The price of purchasing regenerated oil is typically less than 80% of new oil and can be as low as 50%. Ancillary savings increment when considering there is no downtime when reclaiming on energised equipment. Replacement with new oil and hot oil flush requires equipment switch off.

- ***Control of strategic asset is retained*** – Oil in use is an asset. Use of regeneration technology removes dependence on oil companies to deliver replacement supplies and isolates from wildly fluctuating external market prices.

*From unpublished work by George Hodgson and ESKOM, South Africa, 2001

*Above: Various stages of regenerated transformer oil*

Suite 125 ● 425 Hespeler Road ● Cambridge ● Ontario ● N1R 8J6 ● Canada ● Tel: +1 519 756 8890 ● Fax: +1 519 340 0258 ● E-mail: sales@redragon.ca

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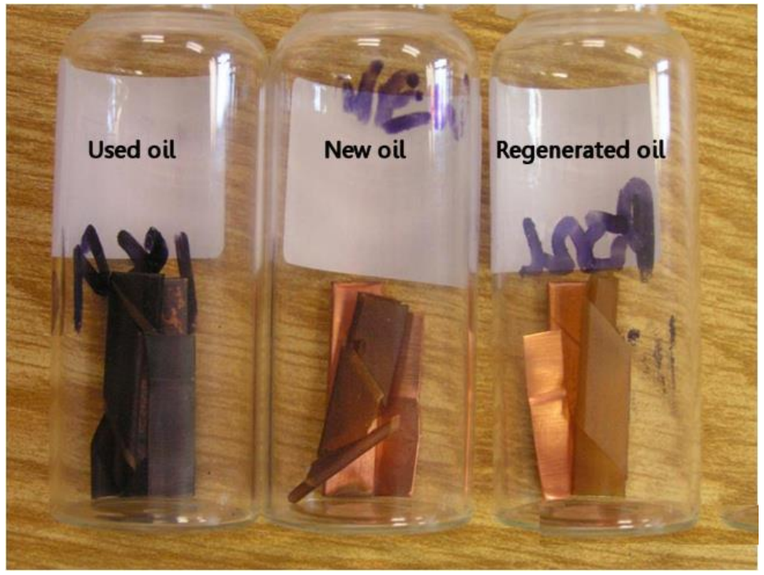
- ***Removal of corrosive sulfur*** –
  Lower quality transformer oil contains DBDS (Dibenzyl Disulfide) as corrosive sulfur. Corrosive sulfur has been identified as the cause of several transformer failures in recent years. Fully regenerating using the TORS removes DBDS and obviates the requirement for passivating the oil, reducing oil maintenance costs and providing peace of mind.




*Above: Corrosive sulfur tests on used, new and regenerated oils per ASTM 1275 Method B*

- ***Processing on energized transformers*** –
  The TORS units are designed to operate on energized transformers as effectively as on un-energized transformers. There is no loss of income, as there would be for an oil change-out, if the transformer is processed energized. The additional advantage of this process is that the transformer core is treated at the same time and the transformer can be completely de-sludged – a benefit not accrued with retro-filling.

**Typical TORS unit specification** – a guide only and subject to change

| Model | Flow rate US GPH nominal | Oil heater kW | Vacuum pump $m^3h^{-1}$ (CFM) | Roots booster $m^3h^{-1}$ (CFM) | Chamber inches, $\phi$ | Oil pumps kW (HP) | Supply required Amps at 380V (480V) |
|---|---|---|---|---|---|---|---|
| TORS-100 | 25 | 3 | 6 (4) | N/A | 14 | 4 (3) | 25A (20A) |
| TORS-500 | 125 | 9 | 25 (20) | N/A | 14 | 4 (3) | 40A (32A) |
| TORS-1000 | 250 | 16 | 63 (41) | 280 (200) | 20 | 5 (6) | 60A (50A) |
| TORS-1500 | 400 | 32 | 165 (117) | 560 (400) | 20 | 5 (6) | 90A (80A) |
| TORS-2000 | 500 | 32 | 200 (141) | 765(540) | 20 | 5 (6) | 120A (100A) |
| TORS-3000 | 800 | 48 | 255 (180) | 1000 (705) | 20 | 5 (6) | 160A (130A) |
| TORS-4000 | 1000 | 64 | 300 (212) | 2000 (1410) | 20 | 7(9) | 200A (160A) |
| TORS-5000 | 1250 | 80 | 400 (330) | 2000 (1410) | 25 | 7(9) | 250A (200A) |
| TORS-6000 | 1500 | 96 | 500 (413) | 2600 (1835) | 25 | 7 (9) | 300A (250A) |
| TORS-10000 | 2500 | 160 | 1000 (704) | 3825 (2700) | 30 | 11 (15) | 400A (320A) |

| Model | No. of columns | Inlet size mm (in) | Outlet size mm (in) | Vacuum line mm (in) | Length mm (in) | Width mm (in) | Height mm (in) | Weight kg (lb) |
|---|---|---|---|---|---|---|---|---|
| TORS-100 | 2 x 1 | 12 (1/2) | 12 (1/2) | 12 (1/2) | 3650 (144) | 1800 (72) | 2450 (96) | 3000 (6600) |
| TORS-500 | 2 x 2 | 19 (3/4) | 19 (3/4) | 25 (1) | 4500 (180) | 2100 (84) | 2450 (96) | 4800 (10500) |
| TORS-1000 | 2 x 3 | 25 (1) | 25 (1) | 40 (1-1/2) | 4500 (180) | 2450 (96) | 2450 (96) | 6400 (14000) |
| TORS-1500 | 2 x 5 | 25 (1) | 25 (1) | 50 (2) | 6000 (240) | 2450 (96) | 2450 (96) | 7500 (16500) |
| TORS-2000 | 2 x 6 | 40 (1-1/2) | 40 (1-1/2) | 50 (2) | 6000 (240) | 2450 (96) | 2450 (96) | 8600 (18900) |
| TORS-3000 | 2 x 9 | 40 (1-1/2) | 40 (1-1/2) | 50 (2) | 7600 (300) | 2450 (96) | 2450 (96) | 9500 (20900) |
| TORS-4000 | 2 x 12 | 40 (1-1/2) | 40 (1-1/2) | 50 (2) | 9100 (360) | 2450 (96) | 2450 (96) | 10400 (22800) |
| TORS-5000 | 2 x 15 | 40 (1-1/2) | 40 (1-1/2) | 75 (3) | 9100 (360) | 2450 (96) | 2450 (96) | 11600 (25500) |
| TORS-6000 | 2 x 18 | 40 (1-1/2) | 40 (1-1/2) | 75 (3) | 9100 (360) | 2450 (96) | 2450 (96) | 12700 (28000) |
| TORS-10000 | 2 x 30 | 50 (2) | 50 (2) | 150 (6) | 12200 (480) | 2450 (96) | 2450 (96) | 17000 (37400) |

**System Add-ons**

- DBPC blend-back modules
- Equipped onboard laboratory
- Remote control and monitoring
- Personnel amenities
- Selection of inline instrumentation
- Custom SCADA and HMI interfaces
- Mobile options including semi-trailer, canvas-side trailer, tagalong trailer, sea container, castors.


*Left: TORS-4000 in canvas-side trailer*

*Right: TORS-2000, skid-mounted*



Suite 125 ● 425 Hespeler Road ● Cambridge ● Ontario ● N1R 8J6 ● Canada ● Tel: +1 519 756 8890 ● Fax: +1 519 340 0258 ● E-mail: sales@redragon.ca