

# Gear selection

by Jensen & Helmke

**Gears and drives are an area of plant management where large gains in energy consumption can be made. Plant operators also need to achieve reliable and controlled performance, and this can be achieved with regular oil filtration. CC Jensen explain why this area of maintenance is vitally important in helping gear and drive systems obtain long service lives.**

**In addition, Helmke provides a case study of how its Soft starter allowed a cement plant in the Caribbean to get its ball mill back into operation.**

## CC Jensen A/S

Filtration is a very important, but unfortunately often neglected tool for the effective maintenance of cement mill gears. The majority of all problems with gear systems are caused by contamination particles in the oil. Overheating and water in the oil should also be avoided in order not to damage components and oil.

Maintaining the oil free of particles, water and oxidation residuals means considerable savings on the maintenance budgets. A very contaminated gear oil may contain up to five million particles per 100 ml; particles which wear, grind and eventually may destroy the expensive components inside an industrial gear box.

The contamination in the gear oil originates from various sources – in fact, the oil is often contaminated before it is filled on the gear box. It is important to note, however, that the majority of the contamination intrudes/is produced by the gear system during operation or, very often, during repair and maintenance work.

### Particulate contamination

A very contaminated gear oil may look very clean to the eye. The naked eye can only see particles larger than four hundredths of a millimetre (40:µm). But the majority of the particles in a contaminated gear oil are around five thousandth of a millimetre (5:µm). Particles smaller than five micron act as catalysts to the oxidation and, consequently to the decomposition of the oil

and, eventually, it will be necessary to change the oil.

Furthermore, metal and other particulate contamination (like cement dust) will continuously flow to the bearings and the gear wheels where the particles may create massive damage to the components. In turn, this damage may cause unplanned production stops which, on top of lost production time, may imply costly repairs or even renovation.

The economical aspects of good oil maintenance are equally obvious. An example: cement mills often use excellent and expensive synthetic oils. The potential lifetime of such oil is at least 60,000 operation hours, but contamination can make it necessary to change the oil after just one year, which of course was not the intention.

Changing the oil also does not remove all the particles sticking inside the system components and piping, and as soon as new oil is poured into the system the oil gets contaminated – filtration is a necessity.

The above actually describes the very evil contamination circle of an oil system, and it is a fact that the number of particles and the oxidation ration will continue to increase if the oil is not cleaned effectively and continuously.

Some manufactures of cement mill gears such as FLS/MAAG in Valby, Denmark, have offered its customers CJCTM Offline Fine Filters for many years. The reason is



Helmke advises on its Soft starter

that FLS/MAAG recognise the importance of a good and oil fine filtration in order to maintain a good level of oil cleanliness for the benefit of both components and oil in its gear boxes.

### Filtration principles

There are many ways of cleaning oil, but the most effective method is offline filtration by means of a filter unit with a separate pump, working independently of the existing gear oil system.

First, however, we will go through the principle of inline filtration in order to make the somewhat different philosophy of offline filtration more comprehensible.

### Inline filters

Cement mill gears are very often equipped with a factory-fitted filter – typically an inline filter integrated in the cooling and lubricating circuit of the gear. The filtration degree will often not be better than 20µm. A filter of this type will obviously assist in retaining a part of the large particles from the oil system. However, the important small particles, oxidation residuals and water will not be removed by this type of inline filter. Consequently, the oil maintenance on such a system is relatively poor and will have a very low effect on reducing overall maintenance costs.

### Off-line filters

In the long-term an investment in a true offline filter will be the wiser solution, provided that the filter inserts used has a large dirt holding capacity and ability to absorb oxidation products and water from the oil.

With its separate pump the offline filter acts as a 'vacuum cleaner' removing dirt from the oil sump. The principle is that the filter pump draws the oil from the bottom of the tank where the concentration of settling impurities is biggest. The oil is pumped through the filter insert and

returned to the gear box, either below the oil surface or, if adequate, on top of the gear wheels. The flow capacity per hour of an offline filter must be 10 to 15 per cent of the total system oil volume.

A high filter flow does not automatically lead to cleaner oil. A high flow through a fine filter (3-6µm abs) implies sturdy and costly filter inserts, energy loss (high pressure drop), low dirt holding capacity and increased risk of particle blow-throughs.

An offline filter in continuous operation and working with a stable and low oil flow gives the perfect conditions for fine filtration. In combination with a true depth-filter element the offline filter will effectively remove particles, water and oxidation deposits from the oil. The installation of an offline filter unit is uncomplicated and uncostly as it does not directly interfere with any other system oil circuits.

In summary, the advantages of installing a high quality offline fine filter are as follows:

- increased component life time
- longer intervals between oil changes
- reduced expenses to maintenance work and spare parts
- less unplanned production stops
- extended main overhaul intervals.

### CC Jensen – Case study

Aalborg Portland, has equipped its Symetro gears with CJCTM Offline Fine Filters from CC Jensen, in Denmark. The company has also decided to utilise this type of filtration on the gear of its big rotating kilns – and with great success as you can see from the following application study.

#### System

FLS Gear-TD1500, gear with torsion shaft for rotating cement kiln. Oil 370 litres of Mobil GEAR SHC 632.

#### Problem

Oil samples had shown an extremely high particle content, leading to increased wear

*The Portland rotating oven is driven by FLS Gear equipped with TM a CJC Filter for retaining particle, oxidation and water from the gear oil*



Date	01-11	17-12	20-12	07-01	12-02	15-05
Particles>2µm	>500,000	>8,000,000	>215,884	>19,240	>15,489	7242
Particles>5µm	>500,000	>3,257,230	>65,185	>10,004	>6969	5219
Particles>15µm	>130,000	>80,250	>7,080	>762	>549	227
ISO class	20/20/18	24/22/17	18/17/13	15/14/10	14/13/9	13/12/8

and tear on the gear teeth. It was decided to improve oil cleanliness during the forthcoming overhaul of the transmission.

#### Solution

A CJC™ Fine Filter type HDU 27/27 PM-DY with pump flow rate = 90l/h and with CJC™ Filter Insert type B 27/27 (3µm abs) with a dirt holding capacity of four litres. The CJC filter unit is installed on the gear system platform next to the gear housing drawing the oil from the bottom (sump) of the gear box and returning it to the top of the gear wheels.

Oil sample number one was taken out before the overhaul of the system. Sample

number two was taken at filter start up, after overhaul and with new oil.

Samples three, four and five were taken during the test. The achieved reduction from 3,257,000 particles >5µm to 6969 will increase the gear bearings life by a factor five.

Per Munk Bertelsen, Maintenance Manager at Aalborg Portland A/S, Cement Mill said: "I can only recommend the use of CJC Oil Filters – as it helps us saving money on our maintenance budgets".

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