Stephen H Shakeshaft Consulting Ltd
75 Mere Bank, Davenham, Northwich, Cheshire, CW9 8NB.
Tel- 01606 331558 Mobile- 07779 190087 Email- steve@shs-consulting.co.uk

Severe Gear and Tyre Wear on Large Rotating Dryer.

Introduction-

A plant was producing a solid product from the evaporation of a liquor.

Towards the back end of the process there was a large rotating dryer.

A call from the plant maintenance engineer asked me to please take a look at a redesigned gland arrangement that one of her supervisors had made to overcome a perceived problem with the present gland arrangements leaking.

Machinery details-

The machine in question was a large cylindrical vessel.

The product was fed in at one end and was propelled through the vessel to the other end by internal scrolls attached to the inside of the vessel shell.

Internally there were also tubes through which low pressure steam was fed in to provide a heat source for the drying process.

The vessel was supported at each end on a cast iron tyre around the shell of the vessel, each tyre resting on two steel rollers fitted with cast iron running surfaces.

About a third of the way along the length of the vessel there was a girth gear driven from a pinion gear.

Both the tyres and the girth gear were of one piece construction, they were “threaded” along the length of the vessel and secured in the factory prior to the vessel being transported to site and lifted into position.

Description of perceived problems-

The plant maintenance engineer was concerned about recurring product leaks from the feed and discharge ends of the rotary vessel.

There were also increasing problems with the steam and condensate feed and return, but it was the corrosive nature of the product that was giving most cause for concern.

This concern was driven by the high number of accidental chemical burns being sustained on the plant.

The plant had been in production for about a year and a half and the operations staff were still on a learning curve with respect to the hazardous nature of parts of the plant.

To make the situation more pressing, the business position was extremely good for the product and no plant shutdown was envisaged.

The maintenance supervisor had taken on board the engineers concerns and had sketched out a redesigned gland system which he thought would solve the product leakage problems.

I was called to the plant to "approve" the use of the redesigned gland arrangement.

Investigation-

I went to the plant to view the glands that were giving the concern.

Indeed there were signs of leakage from the feed end gland.

It appeared that at this gland there was pressure causing the gland to be pulled downwards causing leakage at the bottom of the gland.

Walking round to the other end of the vessel it was the same situation at the discharge end gland.

It appeared that there was a set up problem with the vessel and that the rollers needed to be moved inwards toward the vessel centre so that the rotational axis of the vessel would be pushed upwards in order to relieve the apparent pressure on the glands.

As I walked on the ground floor level I was going underneath the vessel when I decided to have a look at the arrangement of the rollers to see what the set up was like and if the rollers could be easily moved.

It was immediately apparent that there was severe wear taking place on the surface of the rollers and the tyre of the discharge end.

I walked over to the feed end rollers and the situation was exactly the same.

There was piles of ferrous debris lying on each side of the rollers.

It immediately occurred to me that there was no lubrication of any sort on the rollers or Tyres and that this was causing severe wear to take place.

At this stage it was gradually dawning on me that the leakage from the glands wasn't the problem that I ought to be looking at and that there were other far more serious things going on with the vessel.

I was now wondering what the drive gears were going to be like.

If the vessel had dropped enough to cause problems with the glands, what condition were the gears in?

There were wire mesh sections in the guard near the bottom of the gear where the girth gear and pinion meshed. The rest of the gears being fully enclosed.

A torch shone through the mesh revealed piles of ferrous debris and severe wear probably about half the depth of the tooth profile on the pinion and to a lesser degree on the girth gear.

A complete absence of any lubrication system was quite clearly the cause of the heavy wear.

The wear on the pinion and girth gear being accelerated by running much too deeply in mesh as a result of the extremely bad roller and tyre wear and the entire vessel dropping.

Further investigation-
At this point all thoughts of "approving" modifications to gland assemblies had gone completely to the back of my mind.

I requested a meeting with the maintenance engineer to discuss the findings urgently.

I explained that I did not believe that the glands were a problem, they were simply symptoms of a much more serious underlying problem.

The complete lack of any lubrication to the gears, tyres and rollers was causing wear, meaning that the entire cooler had dropped and made the glands leak.

Apparently, the original equipment suppliers commissioning engineer had told the plant engineer that it was necessary to lubricate the tyres and the girth gear "twice per year".

Naturally enough, this was not documented.

The suppliers manual recommended that they could supply lubrication equipment at extra cost and the user was to ask for details.

I found it quite unbelievable, but the maintenance engineer had actually told the supervisor to shutdown every six months and lubricate the tyres and gears.

Not surprisingly, despite being in the plant lubrication schedule, the half yearly lubrication by painting oil on the running surfaces had been completely inadequate.

But it had given the engineer an entirely false sense of security because until we went

out and I showed the engineer the gear wear and the piles of debris coming off the rollers she didn't believe me that the vendors engineer had advised them incorrectly at all.

The engineer was firmly of the opinion that because it was the manufacturers representative that had told her what was required, he couldn't be wrong and I must have been mistaken.

However, a visit to actually see the wear debris convinced the engineer that there was indeed a serious problem.

Enquiries to the manufacturers in Germany were of little help because they requested that we send the entire dryer assembly back to the factory for detailed assessment.

Eventually, the best that could be obtained from the original vessel builders was set of drawings for the gears so that we could investigate manufacturing them locally in the UK.

Eventually the following plan was formulated-

1 Fit the spare pinion gear as a sacrificial part to buy more time since the part that was in service was set to fail in the foreseeable future. This would buy time to put the rest of the plan into operation.

2 Jack the vessel up and remove the rollers.

3 Fit new tyres to the rollers and machine true.

4 Cut the girth gear off the vessel completely.

5 Remove the pinion assembly.

6 Fit the refurbished rollers and let the tyres down onto the new rollers.

7 Fit a custom designed split girth gear that was designed by a specialist UK supplier. This design meant that we could fit the new gear set without lifting the vessel entirely out and threading a girth gear over the vessel.

8 Designing a split gear meant the whole job could be turned round in less than a third of the time it would have otherwise taken to carry out the job and there was no risky heavy lifts involved.

9 Refit a matching custom designed pinion gear to match the new girth gear.

10 A specialist "on site" machining company came in and machined true the existing

tyres once the new gears and refurbished rollers were installed. Fortunately, there was enough material remaining on the original tyres to allow this to happen.

11 Once the tyres were true, the dryer was realigned, the glands adjusted and the vessel re-commissioned.

Just as importantly as the execution of the job, a specialist lubrication company was brought in to make recommendations regarding lubrication equipment for the new gears and tyres.

A regime of a break-in and then a continued running lubricant was specified for the new gears and solid lubricants were specified for the tyres and rollers.

As a gesture of goodwill, the lubricant suppliers sent a representative to site to oversee the lubrication during the beak-in period of the gears and to ensure satisfactory set up of the automatic lubrication system once the continuous operation phase was reached and the regular lubricant was being used.

Conclusion-

A safety problem relating to chemical burns on a plant processing a chemical liquor to make a solid chemical product had led to a symptom of a problem being treated as the problem itself.

Quite correctly, the need to reduce the exposure to a chemical was focusing the maintenance department on ways to increase the effectiveness of the glands on a rotary dryer.

In actual fact, the glands had nothing wrong really with them.

The cause of the leakage was a complete absence of any form of lubrication to the tyres, rollers or gears of the dryer.

A highly qualified but inexperienced maintenance engineer who had unquestioningly taken as true every word that the manufacturers commissioning engineer had told them had run the dryer without lubrication and had caused serious damage.

As a result the dryer had dropped causing gland leakage.

It is somewhat surprising that a major multi-national chemical company can run its equipment in such a manner, but even with seemingly endless numbers of professional engineers at their disposal, the dryer was still run exceptionally badly.

Once the plan of action had been developed, the custom made two piece girth gear was designed.

A strategy to minimise the plant shutdown period was drawn up.

The eventual refurbishment process was put into action and was exceptionally successful.

Specialist lubrication equipment was supplied and commissioned by a specialist company and the plant was re-commissioned and put back into service without problems.

The gland problems went away and the dryer has continued to operate for several years since with no further problems to either the gears or the tyres.

Only routine monitoring of the lubricants is required to ensure a long and trouble free life of the dryer.

Stephen H Shakeshaft IEng MIMechE MIET MIIE

About the author-

Stephen H Shakeshaft is a Mechanical Engineer based in the United Kingdom. He is the Principal Consultant and Director of Stephen H Shakeshaft Consulting Ltd., an engineering consultancy specialising in optimisation of existing assets and engineering design of new build projects.

Stephen has over 30 years experience of working at the “sharp end” as well as the “back room” of manufacturing industries with clients in the chemical, utility, metals, industrial gases and pharmaceutical businesses.

Stephen is a registered professional engineer in the UK and is a corporate member of both the Institution of Mechanical Engineers and the Institution of Engineering and Technology.

Stephen H Shakeshaft Consulting Ltd. can be found on the internet at the following URL-

www.shs-consulting.co.uk

The consultancy welcomes contact from all who are interested in plant and machinery maintenance, systems and development.