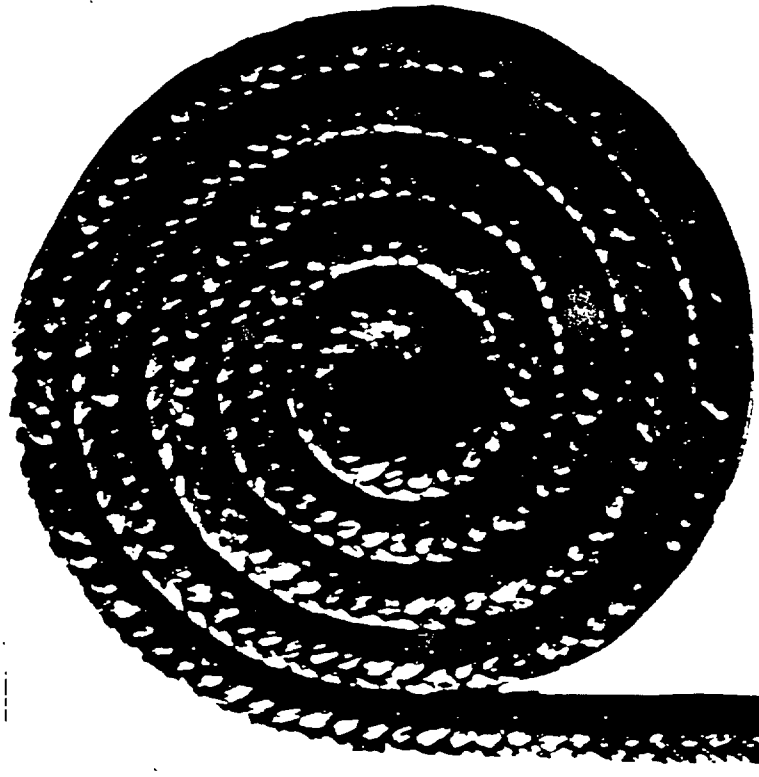
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Breakthrough in packing



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TREATED-GRAPHITE-FILAMENT PACKING being installed in a centrifugal pump

Lasting as long as 2 years in pumps — where another type of packing or mechanical seal lasted only 1 or 2 days — a recently developed braided packing made from treated graphite filament is giving dramatic evidence that it is a breakthrough in the soft-packing field. Major savings in maintenance are being made with it. Also, it has eliminated leakage on some pumping services that could not be satisfactorily sealed in the past by various methods tried.

The outstanding performance being provided by the packing mainly is due to four properties that it has. First, it has a thermal conductivity approaching that of cast iron, allowing the heat generated at the shaft/packing interface to be conducted and radiated away. Second, the material has a much lower thermal expansion than metals used to construct stuffing boxes. This means that swelling from heat is not a problem. Third, the treated graphite filament is resistant to chemical attack. Fourth, it has outstanding temperature resistance.

Monsanto's experiences

Favorable experience resulting from use of the packing is shown by the comments of Pump Engineer Edward C. Aselman of Monsanto Company's John F. Queeny plant in St. Louis, the first chemical plant to use the packing extensively in field tests. The Queeny plant manufactures a wide variety of organic products, the production of which in many instances involves pumping slurries. The plant has about 1200 pumps in service, about 900 of which are packed and 300 of which use mechanical seals. Careful records kept on pump repairs show that about twice as much per pump is being spent on the pumps using mechanical seals as is on those that are packed. Hence, in the view of this experience and the nature of the products handled, the plant is inclined toward the use of the packing.

Some services have been difficult to seal by any means. For example, a life of a few days to 3 or

4 weeks was all that could be obtained with different types of both mechanical seals and packing on one centrifugal pump at the plant. The pump operates at 1750 rpm and has a 2⅛" shaft. It is used for alternating service between hot acid (284 F) and toluene (at ambient temperatures). This temperature change affected the operation of the mechanical seals. The pump was one of the first on which treated-graphite-filament packing was tried. The braided packing provided 25-months service, eliminating leakage.

Treated-graphite-filament packing in another centrifugal pump at Queeny, in toluene-unloading service, has already lasted 25 months, with no rings added. The four nuts on the packing gland are adjusted ½ turn as required. This is a tough service, since the toluene washes out the lubricated packing. The previous packing lasted 4 weeks.

Two weeks to 19 months

A third pump at Queeny has had 19 months service from treated-graphite-filament packing, with two rings added to the original five. This pump, which operates at 3600 rpm, handles 20% sulfuric acid. It is a positive-displacement pump. The life of conventional packing was only 2 weeks. Other types of packing that would have lasted longer would have scored the shaft, making replacement necessary after a period of time — at a cost of $150, plus downtime costs.

The advantage of the high thermal conductivity of treated-graphite-filament packing is illustrated by a fourth installation at Queeny. This is concerned with a rotary, positive-displacement pump, with a 2⅞" shaft, operating at 200 rpm in a lye-unloading operation. Heat would build up, damaging the packing and causing it to lose bulk, so the pump would leak. A water hose was played on the pump (while it was operating) to reduce the temperature. The use of treated-graphite-filament packing eliminated the leakage and made cooling of the pump unnecessary. The packing made of treated graphite had lasted 15 months when the pump was taken out of service.

Another installation at Queeny, using the first graphite packing available, handled a crystalline material at 374 F. Nine-months service was obtained before removal during a bearing replacement. The normal life of previous packings in this service was from 1 to 4 weeks.

As a result of this favorable field experience, the treated-graphite-filament packing has been adopted as standard at the plant's pump-repair station. It is being used on about 99% of the pumps packed, for both process and utility services, according to Mr. Aselman. The pump's economy in utility service is illustrated by one unit in boiler-feedwater service. One end of the pump has been repacked with conventional packing three times; treated-graphite-filament packing it still going strong in the other end.

The Queeny plant is also starting to purchase new pumps equipped with the new packing material, recently purchasing 32 of the pumps.

The idea spreads

After hearing of the favorable field-test experience at the Queeny plant Pump Engineer Al Arnold, of Monsanto's Wm. G. Krummrich plant across the river in East St. Louis, Ill., became interested in investigating the packing. Arnold has the responsibility for the 1600 pumps in use in this plant. The plant manufactures heavy chemicals, such as sulfuric acid, phosphoric acid, phenol, chlorine and caustic, along with about 120 intermediates in smaller tonnages.

The plant uses packing on about 70% of the pumps and mechanical seals on about 30%. Many of the streams contain solids and gritty materials that would shorten the life of a mechanical seal. Accordingly, the mechanical seals are specified primarily for the clean streams, or where the products handled are extremely corrosive, toxic or very costly.

Because of the high initial cost,

The story of treated graphite-filament packing

The background on graphite-filament packing is typical of several others that have grown out of Harold Schneider's Maintenance Engineering Group at Monsanto's Queeny plant. This Group is dedicated to maintenance improvement—in equipment-related and worker-related areas.

In this particular case, Michael P. Blake, a maintenance engineer concerned with rotating-equipment problems, was dissatisfied with the progress made in pump and agitator packing. He did considerable research on the properties of packing and concluded that packing manufacturers seemed to be heading in the wrong direction with regard to several important properties—thermal conductivity and thermal coefficient of expansion being among the most important.

When he read of the development of a graphite yarn[1] for an atomic-reactor application, he felt this might make a better packing material than any then in use.

With this in mind, he consulted the local technical representative of Garlock Inc. and proposed that some packing be made from the material and suggested tests in some pumps in use in the Queeny plant. Garlock agreed to do this and welcomed the opportunity for such a controlled field test.

Garlock's continuing and costly development and testing work coincided with the design of special machinery to handle this extremely friable material. It was necessary to develop surface treatments and reinforcing agents to process the graphite filament. Special controls were devised to assure product uniformity.

Monsanto installed the packing in 1962, as did other companies introduced to the new product by Garlock. Blake made arrangements for careful records to be kept of the pumps using the packing, with the pumps tagged so that a nut was not adjusted without a notation being made.

A year later, Edward C. Aselman took over as pump engineer at the Queeny plant. About this time the Garlock technical representative called on him and asked what the Monsanto field tests showed. Aselman's foremen had continued to keep careful records on the pumps using the treated-graphite-filament packing, and Aselman wrote a report based on these records. It showed the remarkable performance of the new packing. He also placed information on the packing in Schneider's newsletter, which circulates to all Monsanto plants.

Garlock was soon receiving requests and orders for the packing, which was then being made in a semi-works. Allocation was necessary at that time. Based on this interest, Garlock expanded its production capabilities so the demand could be met. The packing has just recently been introduced on a commercial basis.

Aselman points out that, if the Monsanto foremen had not been as diligent as they were in keeping records of the field tests, the development could well have been delayed.

More information on the treated-graphite-filament packing, trademarked Garfite 100[2], and its use in pumps, agitators and other equipment can be obtained from Garlock Inc., Palmyra, N.Y. 14522. Circle 2761 on page 163.

1) Developed by the Carbon Products Division of Union Carbide.

2) Patent applied for

mechanical seals are normally used only where long service life is expected. Arnold points out that a mechanical seal costs about $150-200 installed. If a centrifugal separator is needed to remove solids, this can add another $100-150. A pump can be packed with treated-graphite-filament packing for a material cost of $30 and $15 labor, for an installed cost of $45.

On an initial field test with the braided packing, Arnold solved a tough pump-maintenance problem and is now saving about $100 month in packing costs on just one pump, based on an economic analysis. The product being handled with the 1750-rpm centrifugal unit is monochlorobenzene, containing trace amounts of HCl and other impurities that tend to gum up and corrode a mechanical seal. The monochlorobenzene has little lubricity. Since it is also an excellent degreaser, it would remove the lubricant from a lubricated packing. A mechanical seal was tried and lasted 1 day. Conventional packing lasted 2 days in this service. The treated-graphite-filament packing is still good after 1 ½ years. Six rings were initially installed and then two more after a month of service. The pump hasn't been touched since.

Braid loosely woven

The treated graphited filament braid is loosely woven and gradually compresses as the pump operates until it has the aspects of a graphite bushing. This is why more rings are frequently added in early stages. The shaft of the pump was found to be polished, with no scoring or grooving. The $100 per month being saved doesn't count the saving obtained through elimination of the need to replace scored shafts.

Another field test at Krummrich involved a pump handling nitrobenzene. Mechanical seals were being replaced every few days. The product would crystallize at room temperature. A crystal caught between seal faces would score them and cause the seal to leak. The pump was packed with the new packing in the spring of 1965 and is still operating with no problems.

Equally dramatic results were obtained on eight titanium pumps packed with treated-graphite-filament packing, handling saturated brine. The mechanical-seal life was 3 weeks. The braided packing has been satisfactory since it was installed in September 1965.

One field test at the Krummrich plant did not involve a corrosion problem, but a flow stream at 500°F, which contained sludges and tars. The pump is made of ductile iron. Several double mechanical seals were installed during a year without eliminating leakage. Since the new packing was installed in September 1965, leakage has stopped. One ring of packing was added in October.

Based on these field tests, the Krummrich plant is expanding the use of treated-graphite-filament packing. Arnold hopes to standardize on just two packings in the plant — treated graphite filament and white asbestos impregnated with TFE. The latter would be used mainly for utility services.

Packing training program

As a result of using the new packing, Arnold set up a training program on packing of pumps for maintenance men. The treated-graphite-filament packing is no more difficult to install than any other type. However, the plant engineers found that, when conventional packing life was short and the packing inexpensive, care in installation did not seem so important. With the new packing, proper installation is necessary to obtain the desired long life. Also, plant engineers obviously do not want to waste the relatively expensive material.

Although the two Monsanto plants have done most of the field testing of the treated-graphite-filament packing, other companies have also used it successfully. For example, the Union Carbide Chemicals Division plant at South Charleston, W. Va., has it in 11 centrifugal pumps handling concentrated sulfuric acid containing suspended carbon. The packing has been in service since April 12, 1965, and has been found to be superior to any packing or seal arrangement used over the past 10 years. Leakage has been negligible compared to experience with previous packings. The importance of installing and adjusting the packing properly is emphasized by Carbide.

Hot uranium salts have been handled for 16 weeks by a pump packed with treated-graphite-filament packing in operation at Mallinckrodt Chemical Works, Welldon Springs, Mo. The best previous service was with a mechanical seal, which lasted 5 weeks. The Hercules plant at Louisiana, Mo., has gone to the new packing on pumps for many services.

Nalco Chemical Company has a pump handling an abrasive colloidal silicate suspension in water. The packing failed every 2 to 4 weeks, spraying product on the bearing and ruining it. A treated-graphite-filament packing installed October 19, 1965, has worked all right so far, according to Don Johnson, plant engineer.

The packing is in the form of loosely braided graphite yarn. Four strands of glass fiber provide reinforcement. The packing remains stable in the atmosphere to 650°F and in steam to 1200°F. It resists practically all chemicals. It is not recommended for fuming nitric acid, oleum, dichromates and hot, fuming sulfuric acid. ■