LA-UR-03-9274

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Form 836 (8/00)

Sixteenth Quarterly Report – Three-Phase Centrifuge Control System

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Review

Los Alamos National Laboratory has been working with Centech Inc. of Casper Wyoming to build an intelligent setup and control system for a three-phase centrifuge that was designed and is operated by Centech. Los Alamos is designing and building a setup and control system that will make it possible for non-experts to operate the Centech machine. Currently, only Neal Miller, the inventor of the centrifuge, can operate the centrifuge in an optimal manner. With the intelligent control system less experienced operators will also be able to operate the centrifuge in a near optimal mode. Without the control system this "one operator" limitation reduces the potential impact that this centrifuge technology can have on US oil field and refinery environmental problems. The three-phase centrifuge is a portable device that is used for cleaning up oil field and refinery wastes. The centrifuge, in addition to supplying clean up services, recovers pipeline grade oil from the wastes. It therefore has the potential to help somewhat with the US energy supply problems also.

Accomplishments —first quarter-- FY04.

We were only able to get one good run with Centech in the last quarter of FY03. It was an excellent run with everything working. It demonstrated that we needed to allow for a longer residence time in our feed-forward software. We have made that fix. We were set to go on site with Centech at a job near Newcastle Wyoming. This job would have started at the end of the last fiscal year and carried on into the beginning of this new fiscal year. Unfortunately, the Sunday evening before we were scheduled to leave for Newcastle, Centech called and told us that the centrifuge heater had lost nearly all of it's elements and they would have to run the job essentially cold. This meant that we could not test our feed-forward control system since we both need to control the heater temperature and we also rely on the heater power requirements to provide information about changes in feed composition. Our going would have been a complete waste of time under those circumstances. Therefore we cancelled that trip.

Unfortunately, Centech has not been able to secure any new work since then, so until they do we cannot test our control system further.

We have purchased a new flow meter, however. This flow meter is an EMCO SONO-TRAK flow meter—Model ST-30-RS2-n-250-1-25-12 with RS232 interface including signal strength for percent solids monitoring.

This meter will supplement the current meter, one that seems to be somewhat fragile and has broken down frequently in the past. But the main attraction for the new flow meter is not that. It is the fact that we think that we can successfully measure solids content with this meter, although the meter was not designed for this. We have tested this meter in the field as a "loaner" in the past. We found that the signal strength was a function of solids content. We were not able at the time to find the exact functionality of the meter at the time (linear, quadratic, ?) because we were working with the wax solids in the Chevron-Painter field in Evanston Wyoming. Even though the flow meter was able to detect the wax solids in the feed, when the feed was analyzed to determine percent solids in the bench centrifuge, used for such testing, they disintegrated in the solvent. We just couldn't get an accurate reading for correlation. This will not happen with the other solids that we have run into at every other site. So on our next run we need to correlate the signal strength with percent solids using normal feed.

Both flow meters use sound for flow detection. The old meter bounces sound off of the particles flowing in the feed stream in order to detect rate of flow. This meter will absolutely not work, with clean fluids. The new meter bounces sound off of the pipe wall and measures the echo further down stream to detect flow rate. This meter will function with up to about 30% solids. Although on some feed streams there have been greater than thirty percent solids (Not total BS&W), it is fairly uncommon. The signal strength, not the meter reading, is affected by the amount of solid in the stream. We are getting a special adapter (RS232 interface) so that we can read the signal strength with the computer and therefore detect the solid content of the feed.

As we have stated in the past. The soft-sensor currently is used to detect the difference between the solid and the water in the BS&W in the feed. We have spent a great deal of time and effort on the soft-sensor and it is still the weakest link in the system. If we can get a good determination of the solid in the BS&W in the feed (Which we can measure), then we can get the water content by difference. This should be very effective up to 30% solid in the feed. Beyond 30% we will still have to rely on the soft-sensor, but this will really reduce the size of the soft-sensor code. We can concentrate on really "beefing" up the small section of the soft-sensor code that does heavy solids. (This will probably be for less than 5% of the feeds that Centech will encounter.) The other 95% of the readings will come from a hard instrument reading. This will greatly enhance the reliability of the feed-forward portion of the control code.

Now all we need is a good test site with Centech so that we can correlate and test new meter.