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A One Inch Line - by Eric Fraser - Kansas Water Technologies

It was springtime and all was right with the world. Well not completely… there was a little problem brewing in one of my accounts. The ammonia plant had just had a turnaround and maintenance personnel had noticed white sodium deposits on the reformer catalyst and reformer tubes. For an ammonia plant the catalyzed steam reforming of natural gas is the key production process. Protecting the catalyst is critical. Sulfur in the natural gas has to be completely removed and steam purity is not an option.

The catalyst had to be replaced at more $500,000. More importantly production was lost due to having to extend the turnaround to replace catalyst. Production was also lost because reforming efficiency had dropped off. Total plant losses were more than $1,000,000. We had some serious discussions about steam quality with the plant manager, the ammonia plant superintendent and plant and corporate engineers.

The plant had two 350 psig gas fired water tube boilers and one 350 psig water tube waste heat boiler recovering heat from the reformer. The boiler feedwater was softenend and deaerated. The boilers were inspected and the steam separation equipment was all intact. The boilers were treated with a polymer/chelant product which contained an antifoam. The control of boiler blowdown conductivity and chemical levels at the plant was good to excellent.

The major use of the steam at the plant was for steam reforming. There was also steam used to drive turbines for compressors, process preheaters, waste heat boiler preheat, and steam tracing for freeze protection during winter months. Where possible the steam was trapped and returned to the deaerator at the main boiler plant. The steam to some of the steam tracing was occaisionally sewered. The steam to preheat the waste heat boiler was direct injection so no condensate was recovered there.

After the turnaround we began a steam sampling procedure. We set up sample coolers to sample the steam off the waste heat boiler and the two gas fired power boilers. Because the plant had access to atomic absorption analysis we sampled for steam sodium levels every week. The sodium values were all less than 8 ppb and we thought we were home free.

A couple of months later during a routine service visit the ammonia plant superintendent expressed concern about the poor conversion rate at the reformer and that he still suspected poor steam quality. What could be going on? What could we do about it?

What was really going on?

Our first suspicion was that the boilers may be carrying over or priming intermittently. We set up a continuous sodium analyzer to constantly track sodium levels in the steam line. The analyzer was set up downstream of where the waste heat boiler steam entered the main steam line. We continued to get reasonably low sodium values with the continuous analyzer.

After a couple of weeks of continuous monitoring and head scratching we were still uncertain of the cause of our "apparent steam quality" issue. As a last resort we decided to track every steam line between the analyzer and the reformer. We had done this earlier but we were desperate and perhaps we had missed something.

It is then that we discovered the 1" line providing preheat to the waste heat boiler. We didn't know that it existed prior to that time. They had the waste heat boiler installed only a year earlier. The line was installed as an afterthought to preheat the waste heat boiler mud drum during startups. It was a small line and it wasn't even on the prints of the waste heat boiler installation. The procedure was to shut the preheat line off once the boiler was up to temperature. Nobody gave it much thought and some of the operators didn't know what it was for.

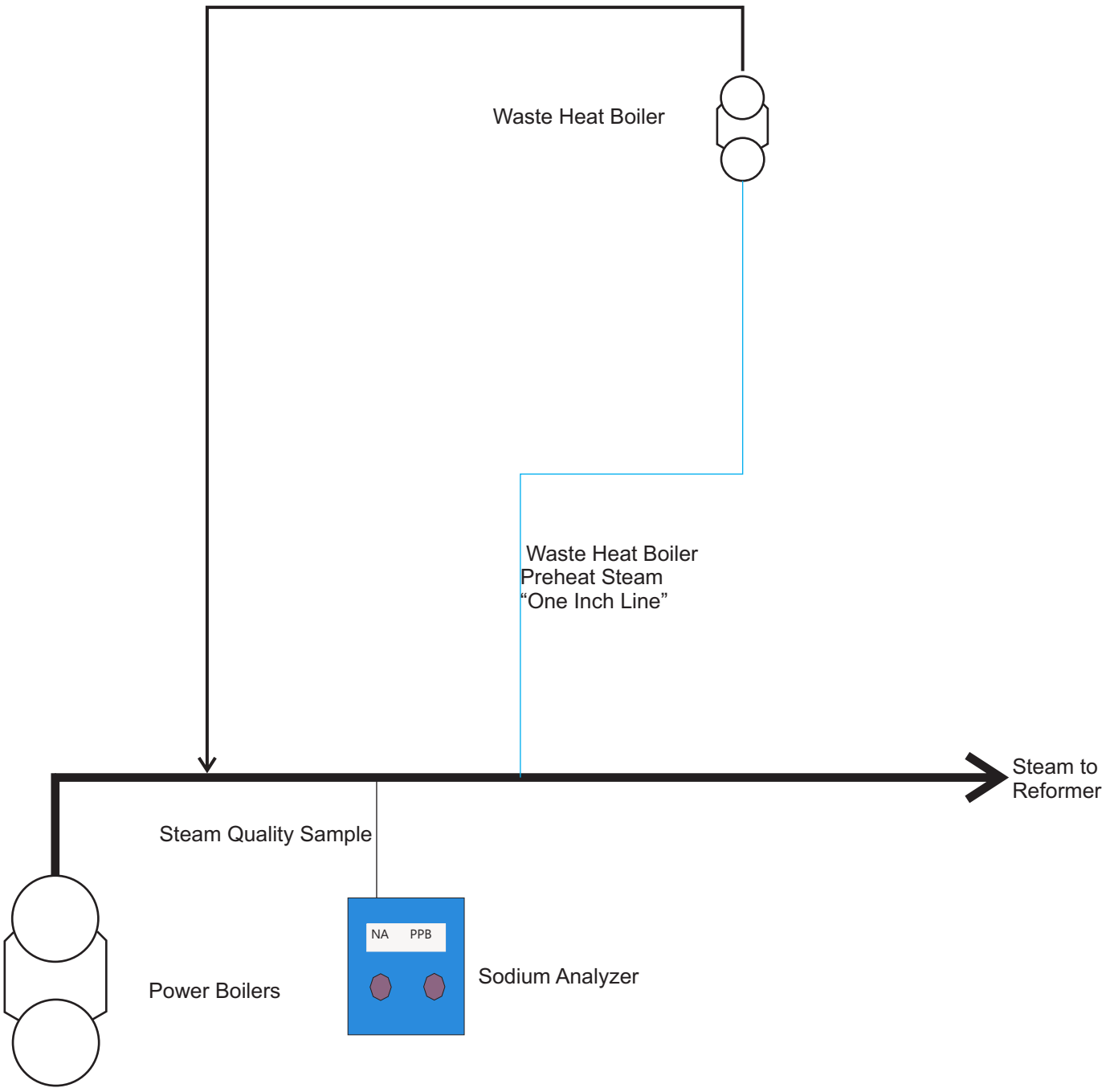
The line would not have been a problem if it had been shut off after startup of the boiler. We found out later that the operators had opened it during the winter because they assumed that line was part of the freeze protection system. They didn't want the line to freeze so they cracked it open. They forgot to close it in the spring.

Because the boilers and the waste heat boiler operated at the same pressure the line would not have been a problem but for the fact that the waste heat boiler was 50 feet above the steam line. The head pressure of the water in the mud drum added to the waste heat boiler pressure was enough to force water into the steam line.

In hind sight our water testing of the waste heat boiler had shown erratic treatment results. (Even though the control in the boiler house was good.) We made assumptions that this was due to changes in the reformer operation and not having automated blowdown control. After all it was only a waste heat boiler!

There were a lot of lessons we learned from this little 1" line. The next week during our service visit, we were looking for the waste heat boiler preheat line. It had been cut and capped on both ends. The ammonia plant superintendent decided he didn't really need to preheat the waste heat boiler afterall!

See Plant Schematic on Next Page



Troubleshooting Case History Schematic