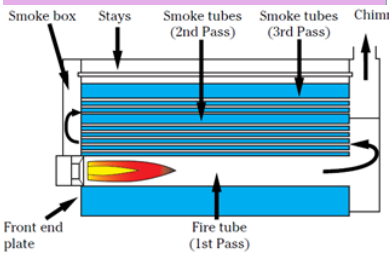
MATTHEWS INTEGRITY HUB

HEAD OFFICE

FAILURE BRIEFING

FAILURE OF A PACKAGE BOILER: MALOPERATION



'Fire tube' layout

THE ARRANGEMENT

The photos show a 1-year old shell-type package steam boiler installed in a brewery. It has a 'fire tube' layout with the water contained in the cylindrical shell surrounding the tubes. In this particular boiler the water level is controlled by three 'Mowbray' level columns operating the switches and alarms.

Boiler door blown off

THE FAILURE

In the middle of one operating shift there a large explosion was heard accompanied by the boiler house filling with steam. The burner door was found to be blown off its hinges and the internal cylindrical furnace of the boiler completely collapsed (see photo)

Level control columns

THE CONSEQUENCES

Fortunately, there was no-one in the boiler house at the time so no-one was injured. If anyone had been present they would most likely have been killed by steam scalding. Parts of the boiler door flew off and embedded themselves in the boiler house wall. The boiler was a complete write-off and suitable only for scrap.

The failed furnace tube

WHAT WAS THE CAUSE?

This is not a rare type of failure. It has happened in many shell boilers so it's a fairly easy diagnosis. What do you think caused it? See next page for : **Failure Diagnosis and Lessons learned**

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FAILURE BRIEFINGS

We think it is important in the asset integrity industry to **SHARE INFORMATION** on equipment accidents and failures. This is the main way in which people learn how failures can be prevented and that the same mistakes do not happen again and again.

Most causes of failure are well known and can be prevented by learning from things that have happened in the past

WE INVITE YOU TO PARTICIPATE

The more failure briefings we can show on these pages the better the chance of failures not repeating themselves unnecessarily. If you want to pass on details of failures you've experienced we will be pleased to edit them into our failure briefing format so they can be of greatest benefit to others in the plant integrity community.

HEAD OFFICE

SHELL BOILER FAILURE LESSONS LEARNED

THE DIAGNOSIS

This is one of the most common catastrophic failure mechanisms of shell boilers.

Scale had built up in the small diameter water and steam pipes feeding the level columns. On this boiler there was no automatic blowdown system fitted so the operators had to do the blowdown manually using the simple 3-way plug cocks. As a precaution, the boiler was set to trip out if blowdown had not been carried out for 8 hours. The sensor for this was just a micro-switch on the column discharge valve connected to the control system.

The operators had not been blowing the columns down properly (for 30 -60 seconds or so) but had just been quickly opening and closing the column discharge valve to reset the micro-switch. As a result, all three columns and their feed pipes were full of hard scale.

The water level in the shell dropped and the scaled-up level indicator did not send a cut-in signal to the feed pump. The water level continues to fall until the top of the furnace (housing the flame) was dry. This caused the top of the furnace to become overheated and it failed under external pressure (classic buckling failure). This ripped the tube-to-tubeplate expansion joints open releasing the full boiler pressure into the furnace, blowing off the burner door.

LESSONS LEARNED :How not to let it happen again.

Water quality in shell boilers is often poorly controlled leading to a tendency for scale build-up.

Manuals plug cocks on level columns do not encourage operators to do the blowdown properly. Other types are fitted with special slow-action valves where once started, the blowdown operation has to be completed

Matthews Integrity Hub: HEAD OFFICE is **OPEN EVERY DAY....0730-2200 Monday-Sunday**...That's correct, all week, including holidays.

If we miss your call, leave a message and we will call you back just as soon as we pick it up. Sorry, there's no automated messages, call queueing, voice recognition robots or garbled music. Try it and see.