Koidra

AI CONSULTANT · BIOMASS PELLET PLANT

RCA: Pellet Mill 3 lost three rollers in 18 days

FAILURES
3 rollers, all below 70% of rated life

RATED ROLLER LIFE
1,000 t

DOWNTIME
About 75 motor hours

RECOMMENDED ACTIONS
5, awaiting your confirmation

Summary

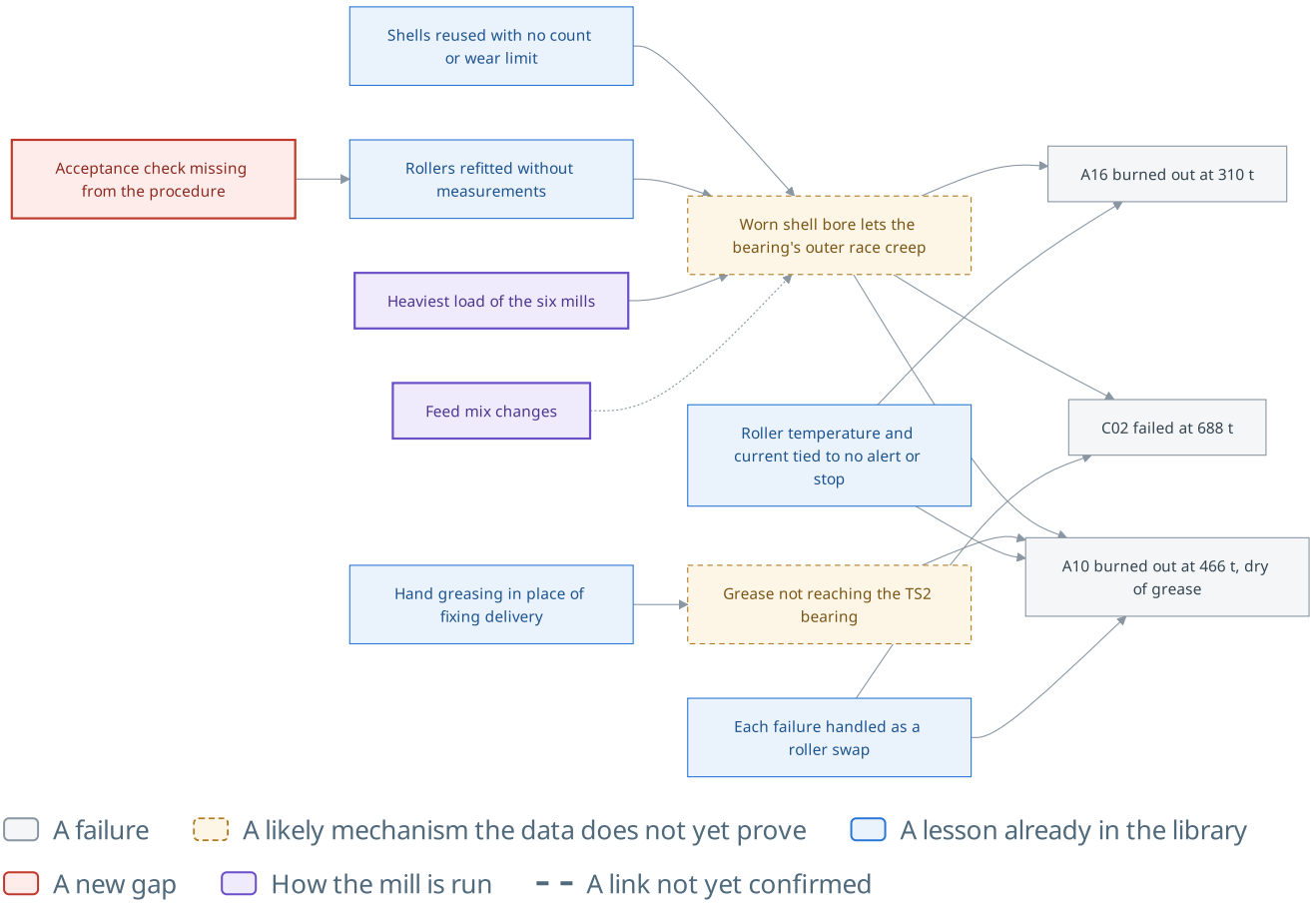
- **Each failed roller had new bearings fitted in a reused shell**, and each time the team swapped the roller and restarted the mill.
- **Maintenance and operation share the cause.** The rollers went into worn shells without measurements, and at least one bearing ran short of grease. Mill 3 also carries the heaviest load of the plant's six mills, and went straight back to heavy load after the 3 November roller change.
- **The data gave a warning.** Before both burnouts on position TS2, that roller's temperature pulled away from the other roller's for one to two hours. There was no alert for it.
- **Five of the gaps repeat lessons already in the plant's RCA library.**
- **Five actions are recommended below.** Four are changes the agent can make in Koidra once you confirm them: procedure steps, alert rules and scheduled work orders. The fifth is a change to how the mill is controlled.

What happened

When	Record	What it shows
16 Oct 23:00	WO-024557	TS2 roller A16 burned out at 310 t, about 2 hours after start-up. New bearings; shell on its second reuse.
17 Oct – 4 Nov	Daily pellet mill checklist	10 of 15 daily checklists skipped. The checklist had no roller item.
30 Oct 15:58	WO-025127	TS1 roller C02 failed at 688 t, with the flange rubbing. New bearings in an old shell. The analysis linked to this work order (MD034) set an acceptance check before any restart.

When	Record	What it shows
3 Nov 00:45–02:48	**SCADA**	**TT02 rose from 41 to 55 °C while TT01 stayed nearly flat.**
3 Nov 02:49	WO-025324	Operators saw the rise and stopped the mill, but TS2 roller A10 had already burned out at 466 t. Shell on its third reuse, outer diameter worn from 400 to 392 mm, bearing dry of grease.
3 Nov 23:48	WO-025324-1	The roller change: 31 steps ticked in 4 minutes, with no measurements or photos. "Test run: passed" was ticked at 23:50; the motor restarted at 07:28 the next morning.
4 Nov 22:35	SCADA	The TT02 sensor worked loose and read 23–25 °C under load for about 12 hours, until an electrician found it on a routine check. No work order records it.

Root cause



Worn shell bore lets the bearing's outer race creep — Likely

Data	All three failed rollers had new bearings fitted in a reused shell. A10's shell was on its third reuse, with its outer diameter worn from 400 to 392 mm. C02 failed with its flange rubbing.
Lesson MD034	The analysis of the 30 October failure named the same mechanism: a worn bore in an old shell lets the bearing's outer race creep.
Source [1]	A bearing ring that is not held firmly in its seat moves against it ("creep"), which damages both the ring and the seat.
Source [2, 3]	Creep grows under a heavy radial load in one direction and wears the seat, so a loose fit gets looser.
Not yet shown	No shell bore was measured, so the wear in the bore cannot be confirmed. Action 1 records it from now on.

Shells reused with no count or wear limit — Shown

Data	The reuse count of each shell appears only in work order notes. No procedure step records it, and none compares it with a limit.
Lesson MD029	Two failures on one mill call for an analysis of the whole roller assembly, shell included.

Rollers refitted without measurements — Shown

Data	In WO-025324-1, 31 steps were ticked in 4 minutes, with no measurements or photos. "Test run: passed" was ticked at 23:50; the motor restarted at 07:28 the next morning.
Lesson MD005	A checkbox with no measurement always closes as "passed".

Acceptance check missing from the procedure — New gap

Data	MD034 set an acceptance check before restart on 2 November. The roller change procedure did not change, and the next roller change, the next day, skipped the check.

Grease not reaching the TS2 bearing Likely

Data	A10's bearing came out dry of grease. Operators were adding 450 g a day by hand to make up for the automatic delivery.
Lesson QN037	Extra hand greasing hides a delivery fault instead of finding it.
Source [1]	Too little lubricant lets the surfaces touch; the friction heats them locally and can end in seizure.
Not yet shown	Nobody measures how much grease reaches each roller. Action 4 adds that reading.

Heaviest load of the six mills Shown

Data	From 20 October to 5 November, Mill 3 averaged 462 A against 416–440 A on the other five mills, and ran 404 minutes above 550 A against 44–325.
Data	The two heaviest days (25 and 28 October, 95 and 89 minutes above 550 A) came in the five days before TS1 failed. After the 3 November change the mill went straight to 87 minutes above 550 A, with no run-in.
Source [2]	A heavy radial load in one direction strains the outer ring and drives creep.
Not on its own	The 3 November burnout followed two light days with no minutes above 550 A, so load adds to worn shells and poor greasing rather than replacing them.

Feed mix changes Not ruled out

Data	On 16 October the mix changed from 3 bark : 1 mixed wood to 5 mixed wood : 1 acacia. 30 October and 3 November ran 2 bark : 1 mixed wood. From 22 to 27 October, on 3 chipped mixed wood : 1 acacia and rubberwood, nothing failed.
Not on its own	No single mix is common to all three failures.

Roller temperature and current tied to no alert or stop Shown

Data Before both TS2 burnouts, TT02 separated from TT01 and kept climbing for one to two hours. A fixed temperature limit would have missed it: the peak was only 55 °C. Before the TS1 failure, the motor current rose to 596 A while the feeder slowed from 42 to 36.5 Hz. Mill 3's daily readings are below.

Lesson MD021 The pellet mills have no temperature alerts. There were still none on 3 November.

Date	Avg current (A)	Minutes > 550 A	TT01 max (°C)	TT02 max (°C)	TT02 − TT01 max (°C)
16 Oct	486	11	31.7	53.8	**22.1**
25 Oct	507	95	39.0	47.5	11.5
28 Oct	497	89	47.3	49.4	11.2
30 Oct	472	8	54.5	52.0	9.1
2 Nov	433	0	37.2	44.7	10.0
3 Nov	449	0	38.5	55.3	**18.4**
4 Nov	505	87	41.8	39.9	0.1
5 Nov (to 15:44)	510	66	34.2	33.7	−0.3

Only minutes under load count (current above 300 A). Outlined cells mark a failure day; shading marks heavy load or a roller running hotter than its pair. One reading of 237.03 °C is left out, because it appears at the same moment on all six mills.

Each failure handled as a roller swap Shown

Data All three work orders closed with a roller swap and a restart. In WO-025324, 7 mandatory root cause steps are still unanswered.

Lesson MD029 Two failures on one mill call for an analysis of the whole roller assembly.

1. ISO 15243:2017, *Rolling bearings. Damage and failures. Terms, characteristics and causes.* International Organization for Standardization. iso.org/standard/59619
2. Y. Ishii and T. Jinbo, "Development of Anti-Creep Ball Bearing for Outer Ring". *JTEKT Engineering Journal* No. 1014E, 2017. PDF
3. Zhan, Yukawa and Takemura, "Analysis of Bearing Outer Ring Creep with FEM". *Advanced Tribology*, Springer, 2009. doi:10.1007/978-3-642-03653-8_74

Recommended actions

1 Accept every rebuilt roller on measurements, not ticks

All three failed rollers went in without a recorded measurement, and the last test run was ticked hours before it happened.

IN KOIDRA: UPDATE TWO PROCEDURES

- Roller inspection and rebuild: Pass/Flag/Fail steps, each with a photo, for the bearings, flange, seals and grease as found when the roller is stripped. Number steps for shell bore and outer diameter (mm) and the shell's rebuild count, with the manufacturer's reuse limit and minimum diameter in the step text.
- Pellet mill die and roller change: number steps for flange clearance and roller-to-die gap (mm). The "Test run: passed" checkbox becomes three number steps after 30 minutes under load: TT01, TT02 (°C) and motor current (A).
- A Fail on any of these steps opens a corrective work order, so a roller that does not measure up is not handed back to production.

Owner: maintenance lead, with the rebuild workshop and production

2 Alert when one roller heats faster than its pair

One roller rises 8 °C or more within an hour under load and runs 5 °C or more above the other. On 21 days of history this warned 18 minutes before the 16 October failure and 55 minutes before the 3 November one, at about two alerts a day across all six mills. A faster rule, 5 °C in 5 minutes, caught none of the three failures.

IN KOIDRA: A NEW ALERT RULE, ONE PER ROLLER ON EACH MILL (12 IN ALL)

```
AND({PM3 Current} > 300,
    {PM3 TT02} - SHIFT({PM3 TT02}, 1h) >= 8,
    {PM3 TT02} - {PM3 TT01} >= 5)
```

- Severity Warning. The responder reads: "TS2 is heating faster than TS1. Cut the feed, check grease delivery to TS2, and stop the mill if the gap keeps growing."
- Each alert asks for a cause and resolution, and can become a work order in one step.

Owner: reliability engineer sets it up; production responds

3 Alert when a roller temperature sensor drops out

The loose TT02 sensor read room temperature under load for 12 hours, and only a routine check found it. One sensor falling 4 °C or more within 5 minutes under load, while the other holds, would have caught it at 22:36 on 4 November, one minute after it came loose.

IN KOIDRA: A NEW ALERT RULE, ONE PER SENSOR ON EACH MILL (12 IN ALL)

```
AND({PM3 Current} > 300,
    SHIFT({PM3 TT02}, 5m) - {PM3 TT02} >= 4,
    ABS({PM3 TT01} - SHIFT({PM3 TT01}, 5m)) < 1)
```

- Severity Warning, turned into a work order for electrical maintenance, so the repair is on record.

Owner: reliability engineer sets it up; electrical maintenance responds

4 Measure the grease each roller gets, and check roller temperatures every shift

The A10 bearing came out dry, while 450 g a day was being added by hand to make up for a delivery fault nobody has measured.

IN KOIDRA: UPDATE A PROCEDURE AND SCHEDULE A CHECK

- Pellet area greasing: a number step per roller for grease delivered (g), from the pump and by hand.
- A new per-shift roller temperature check on each mill, scheduled as a recurring work order three times a day, with a roller item added to the daily pellet mill checklist.

Owner: maintenance for grease; production for the shift checks

5 Spread the load and run a new roller in before full load

Mill 3 carries the heaviest load of the six mills, went straight into heavy load after the 3 November roller change, and kept running on 30 October while its current climbed and its feeder slowed.

OUTSIDE KOIDRA: IN THE CONTROL SYSTEM

- Bring Mill 3's load in line with the other five mills (462 A on average, against 416–440 A), or find out why it draws more current at the same feed.
- After a roller change, run the mill at reduced feed for a run-in period agreed with the manufacturer before it goes to full load.
- Cut the feed automatically when the motor current rises while the feeder slows, as it did on 30 October (596 A at 36.5 Hz).

Owner: control engineer, with the production manager

Actions 1 to 4 can be automated in Koidra: which of them should the agent apply right away?