

Whitepaper

Same average thickness, different realized profit

What flake thickness variance costs your oil yield

Innovations for a **better world.**

BÜHLER

Where the oil ends up
What flake thickness variance can cost you

A soybean processing plant took residual oil content from 0.94% to 0.59% across a five-month period, worth $39,000 in the strongest month. Average flake thickness never moved.

The process of flaking is done to prepare your dehulled and cracked product for oil extraction downstream. Nobody buys the flakes themselves. What leaves the plant is crude oil and defatted meal, of which oil commands roughly triple the price. Residual oil is the oil that never made it out, measured as a percentage of the mass of the flakes and sold at the meal price instead. A tenth of a percentage point is one kilogram in every metric ton of flakes. At the spot prices behind this work, that kilogram fetches 90 cents as oil and 44 cents as meal, so recovering it returns the 46-cent difference on every metric ton you run. For a plant processing 2,000 metric tons of soybeans per day, that translates to $920 every 24 hours. That sounds like a rounding error until you watch a third of a point move.

Bühler's flaking specialists start with a simple viewpoint: the first step in optimizing any process is understanding it. For flaking, that means knowing which number on your control chart actually predicts yield.

Most flakes are never the average

A flaking mill turns out a population of thicker and thinner flakes spread around a mean, with almost none sitting exactly on it. Watch only the mean and you are watching the one number that can hold perfectly steady while yield falls. In the customer project set out later in this paper, flake thickness was measured at six equidistant points across the roll and averaged each month. That average started at 0.38mm and finished at 0.38mm. Residual oil fell by more than a third over the same five-month period.

The width of that spread is what moves the money. Two sets of rolls reporting the same average can return very different profit, because the one running wider variance keeps oil moving into the meal stream instead of the oil stream. Uneven wear on the rolls widens the variance, and residual oil climbs faster than the wear does.

Roll grinding brings the variance back to reasonable levels by producing equal flakes along the full length of the roll. Measure the variance, act on the rolls via roll surface grinding, adjust the roll gap, adjust the hydraulic pressure, and residual oil follows. In flaking, variance is the most telling measure of process performance.



The flaking mill OLFB produces consistent flakes at the highest throughputs. With a compact footprint and integrated control unit, it is the perfect solution for flaking your cracked soybeans and soft seeds with the precision you need.

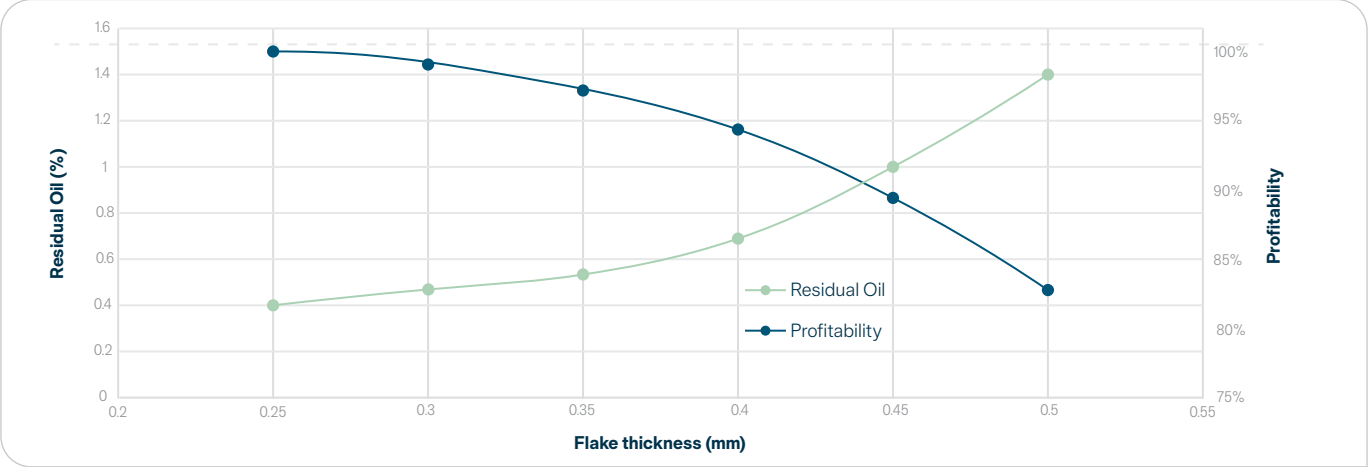


The flaker OLFC is built for maximum uptime. A reinforced frame for lower vibration, larger rolls for longer life and an intuitive touchscreen with real-time insights make it the reliable solution for flaking cracked soybeans and soft seeds around the clock.

The Mechanics
Why variance predicts yield better than average

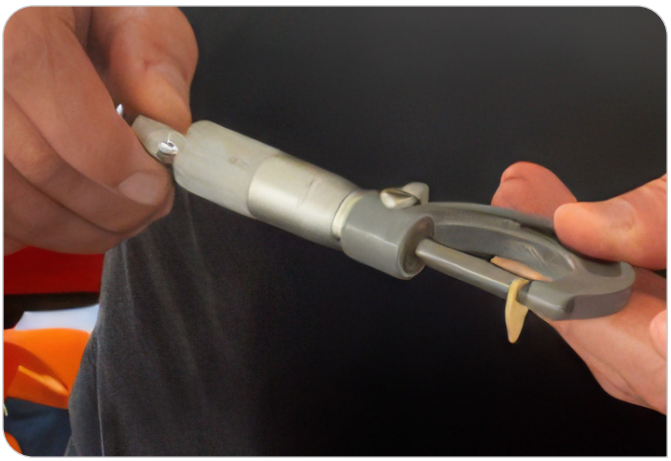
When the flake thickness doubles, the residual oil more than triples. That relationship is what makes variance expensive. The standard measure of flaking efficiency is flake thickness; Bühler looks beyond the average flake thickness to the variance behind it.

The steepness of the curve is the point of interest. For soybean flakes, moving from 0.25mm to 0.35mm flake thickness raises residual oil by 0.14 percentage points. The same 0.10mm increase, but instead from 0.40mm to 0.50mm, raises residual oil by 0.70 percentage points, five times the increase in residual oil for the same 0.10mm thickness change.



Thicker flakes cost plants progressively more, not proportionally more. Profitability here refers to oil-yield value relative to the best-performing point in this dataset (0.25mm = 100%), not an absolute margin figure. Source: Bühler flaking data.

That curve is what makes a wide scatter in flake thickness expensive. A roll running high variance sends part of its output up the steep end of the curve, and the value of the oil those thick flakes trap outweighs the value the thin flakes recover. A 0.40mm average held tightly i.e. with little variance, beats a 0.35mm average flake thickness running loose. Roll condition and roll set up is what drives the scatter. A worn or unevenly ground roll surface cannot hold a consistent gap across the full roll width, so the flake variance widens while the average on the chart holds steady.



Flakes are sampled at six equidistant points across the roll and measured by hand. Six readings indicate how much the thickness varies along the roll. A single reading only tells you about the spot it came from.



Consistent flakes are the output an even and well configured roll surface produces, and the condition under which extraction gets the most oil out.

What tighter variance is worth:
One soybean plant, four flaking mills, five months

A soybean processor running four flaking mills set out to bring residual oil down by controlling flake thickness variance. Flake thickness and residual oil were measured on the line, and the mills were calibrated to close the loop by hand.

Residual oil

0.35 percentage point reduction

From 0.94% down to 0.59% across five months

Additional revenue

$39,000 in the strongest month

Building from $16,000 in the first month as variance came down

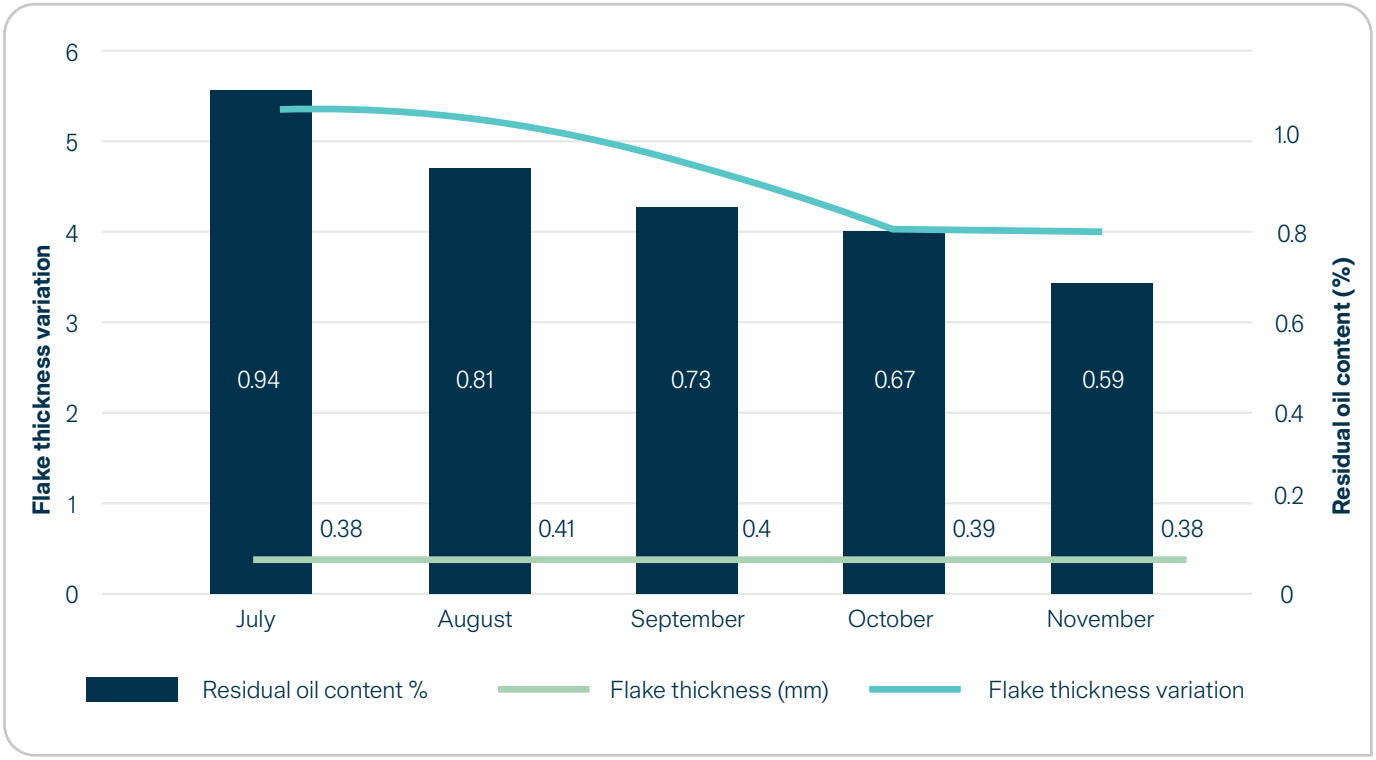
Residual oil is measured as a percentage of flake mass, variation is a unitless figure that shows the spread of data around the mean average. Thickness was read at six equidistant points across the roll and averaged monthly. The gathered readings were acted on and the mills were kept in optimal condition throughout.

Variance is the number worth measuring

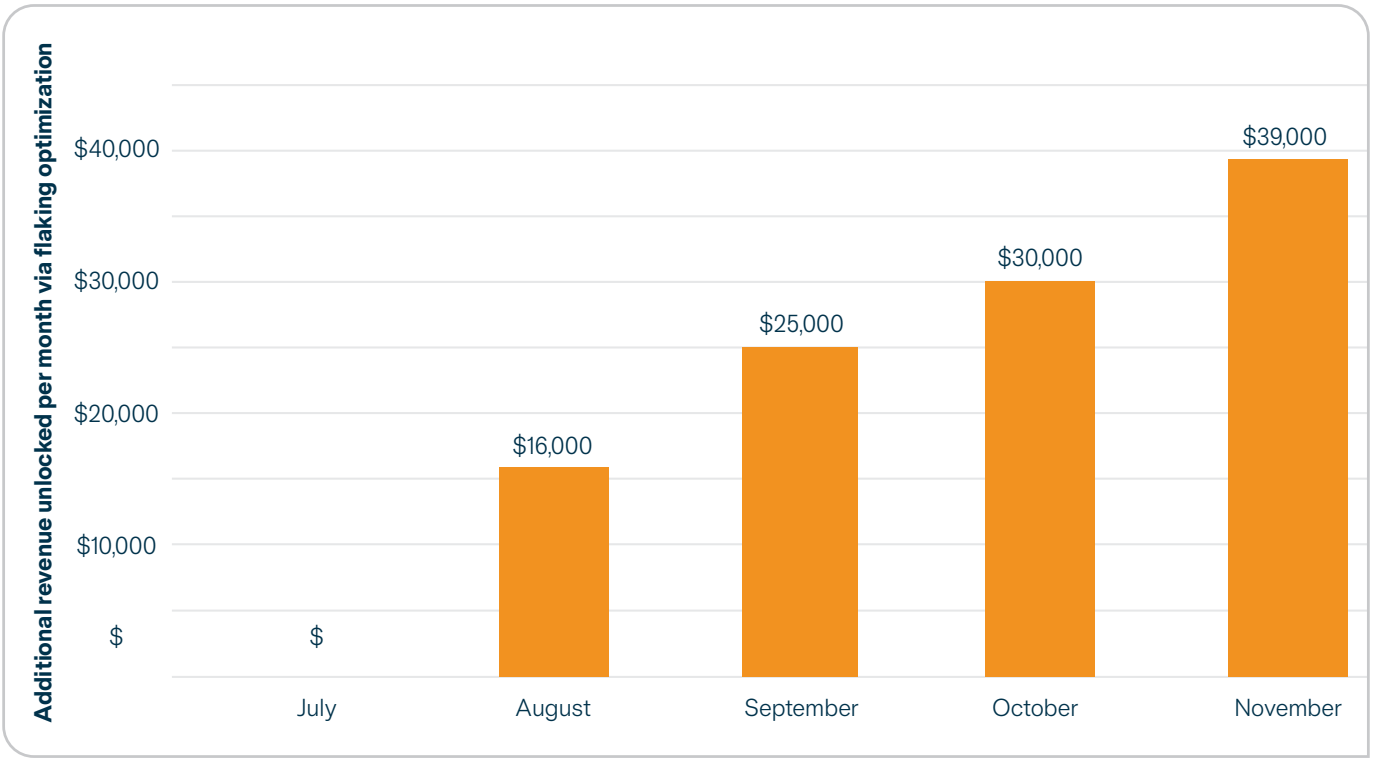
The chart below tracks one plant across five months. Three numbers are plotted and only one of them stays still. Average measured flake thickness finished where it started, at 0.38mm, while the coefficient of variation fell from 5.5 to 4.2 and residual oil content dropped from 0.94% to 0.59%. A plant watching only the average would have seen a flat line and concluded that nothing had changed. The loop is repeatable: measure flake thickness and residual oil content, and then act on the roll surfaces. This plant needed no process redesign, no new equipment, and no interruption to production; only the condition of its rolls was used as the control point. What separates it from no reduction in residual oil is which number they chose to track. Average flake thickness stays reassuringly stable and hides the loss underneath it. Variance is what tells you when to grind.

Bühler's mobile roll revision team reconditions the roll surface without removing the roll from the machine. A grinding head travels the length of the roll on a rail while the roll turns at reduced speed, and an abrasive medium is held against the turning surface to take off a controlled layer.

Average flake thickness held steady. Variance and residual oil did not.



What the residual oil reduction was worth, month by month



Revenue is in USD, across 4 flakers at ~2,000 tpd combined. Intervention began in August.

Sizing of your own plant

Every plant recovers a different amount, but the unit economics travel. Crude oil and meal are separated by roughly $460 a metric ton, $900 against $440. A 0.1 percentage point reduction in residual oil shifts one kilogram per metric ton across that gap, returning about 46 cents on every metric ton of flakes you run.

Annual flake throughput	Value of 0.1 percentage point
250,000 metric tons	$115,000
500,000 metric tons	$230,000
1,000,000 metric tons	$460,000

Arithmetic from spot prices, not customer results. The same calculation runs on canola, sunflower or any other oilseed at your own oil and meal prices. What you recover depends on how much variance there is to take out.

The service
Precision roll-conditioning, on site

The rolls stay in the flaker. A grinding head mounted on a rail does the work.

Four variables are controlled through the revision:

- **Roller speed,** held low throughout, important for surface finish as much as for safety
- **Direction of rotation** of the roll against the medium
- **The medium itself,** selected for targeted removal of the surface layer
- **The angle** at which that medium meets the roll

Low speed does three things at once. It reduces chipping and work hardening, which is what produces the finish on the reconditioned roll's surface. It reduces deflection as the roll turns, since weight is never perfectly distributed around a roll body. And it keeps the work safe to carry out in place. The revision also cuts the downtime of pulling and shipping a roll offsite for reconditioning.



Mobile roll revision in progress. The grinding head runs on a rail at the base of the machine, traversing the roll while the roll turns in place.

What the surface looks like



Before: Pitting and corrosion across the roll's surface. A surface this worn takes significant time to regrind — cutting followed by grinding is optimal, though diligent grinding alone can also work.



After: An even ground surface holds a consistent gap along the full roll length.

How the service runs

01 **Roll inspection**
Surface hardness testing; check for chipping, pitting, and cracking. Roll profile is also assessed to determine whether wear is even, round, or conical.

02 **Precision grinding**
Rolls are ground to customer specifications using either Bühler's grinding equipment and roll slow-down capabilities or the customer's onsite tools

03 **Final inspection and documentation**
Quality check with full reconditioning records

Value for your operation:

- Higher oil yield, from tighter flake thickness variance across the roll
- Lower residual oil in the byproduct, which is revenue recovered at oil price instead of meal price
- Expertly reconditioned rolls
- High throughput and improved operating reliability
- Consistent flake thickness and stable extraction performance
- Reduced maintenance costs and reduced roll damage
- Improved uptime and predictable maintenance planning

Bearing Replacement

Optional bearing replacement improves operational reliability and production safety.
This is strongly recommended as bearings are designed for a limited number of production hours.

Ongoing coverage
The Bühler Roll Care Package

A one-time regrind fixes today's variance. A Bühler Roll Care Package keeps variance from becoming an issue again.

The Bühler Roll Care Package provides proactive maintenance through a predefined number of on-site inspections and reconditioning services, set against the operating instructions for your machines and rolls. Bühler combines deep application knowledge with flexible service models and proven reconditioning capabilities. While on site, our technicians also inspect additional machine components and process conditions, identifying potential issues and improvement opportunities.

Packaged options include:

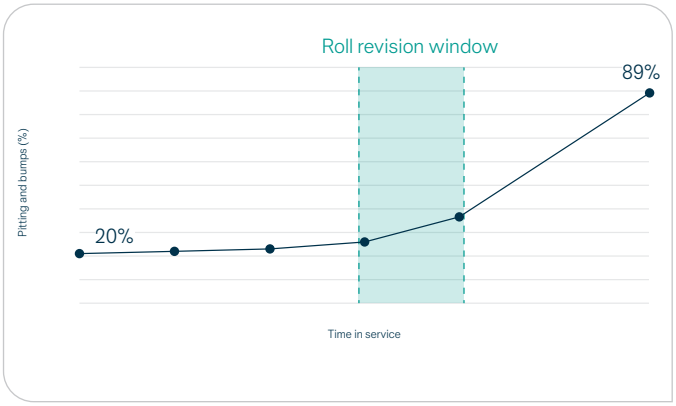
Monthly installments

Annual renewal

On-site Bühler specialist support

Surface wear is slow, then sudden

Pitting and bumps accumulate gently through the early stages of a roll's service life, then accelerate sharply. Bühler's own degradation data shows the surface maintaining a "pitting and bumping" incidence figure of approximately 20% initially maxing out at 89%, with almost all of the damage occurring within approximately 33% of the observed period. The conclusion here is that the rate of roll surface degradation accelerates after a critical threshold has been surpassed.



Waiting for a roll to look worn means waiting until your roll reaches the steeper section of the "Roll revision window" curve, where flake thickness variance is already widening. Scheduled revision catches the surface while the curve is still flat.



Above: Roll grinding in action

A predefined inspection schedule is what keeps intervention inside the roll revision window shown above, rather than after it. That is the case for a proactive package rather than a reactive one-time call out.

What is flake thickness variance costing your line?

Our flaking specialists can assess your current roll condition and recommend next steps.

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