

The Jar Test That Never Stops

A running DAF publishes everything the bench writes down. Reading it as steady-state windows, tied to the lab analysis of the water it was treating, puts the plant and the jar test in the same record, and lets each check the other.

Archer Separation Inc. · pages and charts from a record with names, dates and figures altered

About 3,400 words

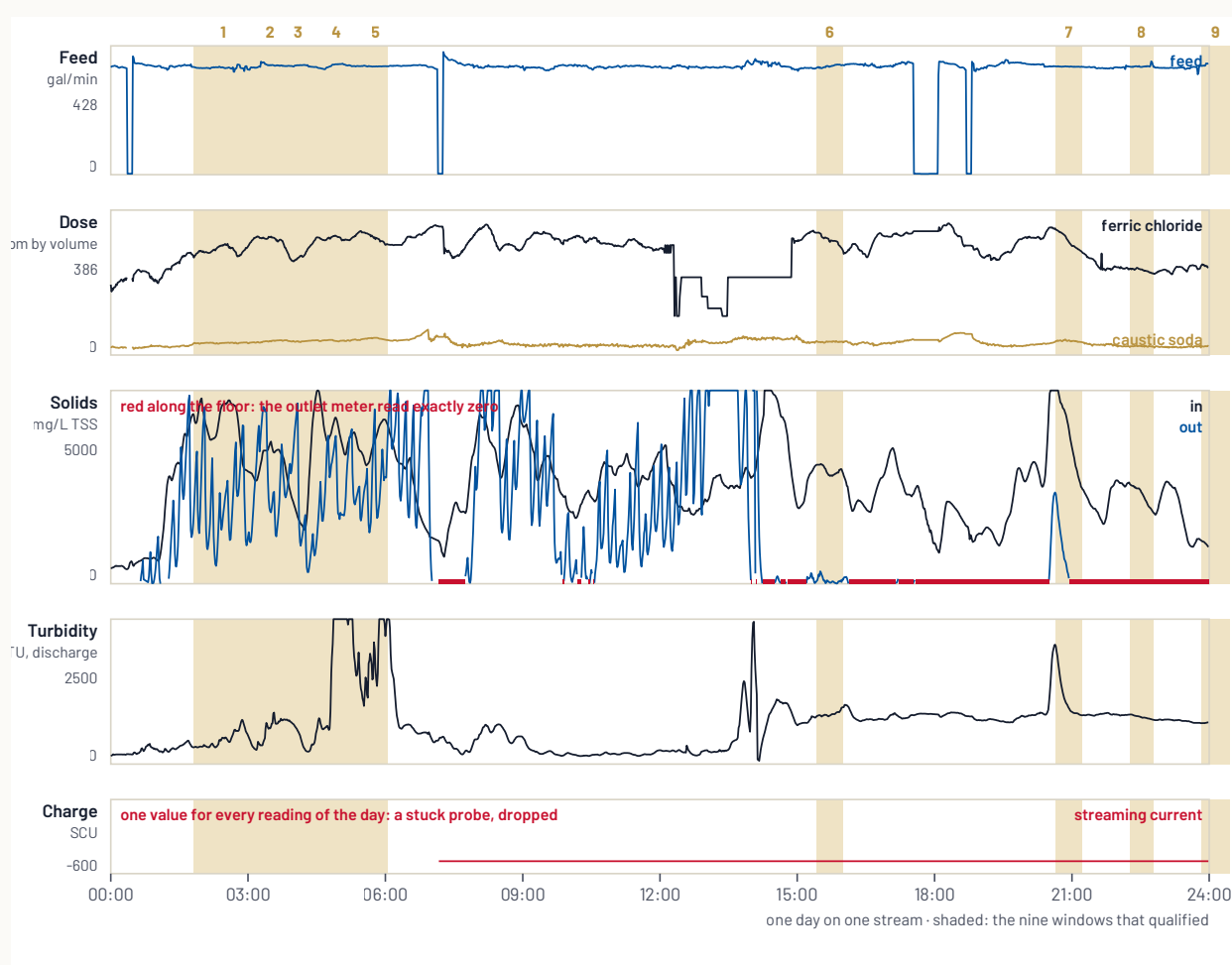
Part one was about the record: every jar as one row carrying its water, the alkalinity budget, the solids a coagulant makes, and the rules a language model has to write under before its name goes on a report. This part is about the largest jar in the set, which is the plant.

A dissolved air flotation unit running on a process wastewater is a jar test that never ends. Influent comes in, coagulant and flocculant go in at a dose, effluent goes out, every minute, all year. The gateway on a modern DAF already publishes what a chemist writes on a bench sheet: solids and pH in and out, streaming current, feed flow, and a pump dose per product in ppm. Field for field, it looks like the jar.

For years that data went to a dashboard. A dashboard is something you look at. A record is something you can ask a question of, and the questions worth asking are the bench's questions: which programme held, at what dose, on which water, and what it cost.

The unit of record is a window, not a reading

A year of five-second data is six million points per tag, and it belongs in the telemetry platform that was built to hold it. What the treatment record wants is the observation: a period where feed rate, doses and setpoints all held still long enough for the effluent to reflect the influent. So the unit of record is a steady-state window. It qualifies when, over a stretch longer than the tank's residence time, feed flow and every dose in service stayed within a tolerance of their own medians, no chemical was switched in or out, and the data did not gap. The window is stored as the median of each tag over that stretch, with its start, its length, how many raw readings it summarised and the feed rate it ran at.



One day on one stream. Feed, the two doses in service, solids in and out, discharge turbidity and streaming current, minute by minute, with the nine windows that qualified shaded. Nothing qualifies through the dose moves in the afternoon or across the feed dropouts. Red along the floor of the solids panel is every minute the outlet meter read exactly zero. The charge probe returned one value all day and was dropped. Figures altered; the shapes are real.

The thresholds that decide what "held still" means cannot be set from an office, and the day above says why. With every control held to within five percent of its median, one window survived the day. At a tenth, the nine shown. At fifteen percent, eleven, one of them reaching across a dose change that an operator would have called two different hours. The honest way is to start loose, count what survives, and tighten until the windows that remain are the ones an operator would recognise as a steady hour. A plant yields perhaps four to ten such windows a day, which is two thousand rows a year against the ten or so jars a bench session produces. That volume is the whole argument for doing it, and it is the volume a dose model will eventually need.

The mapping onto the bench is exact

The temptation is a separate table for plant data. It is the wrong instinct, because everything downstream, the cost per cubic metre, the alkalinity budget, the dose-response curves, the nearest-water lookup, the export a model trains on, already walks the jar. A parallel table means rebuilding all of it and keeping the two in step forever. The mapping is natural enough that nothing has to be forced:

ON THE BENCH	ON THE PLANT
A jar-test session	One day of operation on one stream
A beaker at one dose	One steady-state window
What went in the beaker	The median dose over the window, per product
Before and after readings	Median in and median out over the window
The stopwatch	The window's start, length and point count

Several windows in a day at different doses is a dose ladder, so the same curves the bench draws start working on plant data with no change. That is the tell that the mapping is right rather than convenient. A plant day renders as its own report, with the stream in the facts and a table of

windows where the bench report has its conditions, and in the client's dossier the approach tables carry an on-the-plant row under each pooled row, so the two are read together and never confused.

ARCHER SEPARATION		PLANT OPERATING POINTS	
		No. JT-0048	
CLIENT	INDUSTRY	SAMPLE	
Facility B	rendering	Profile 23	
STREAM	TEST DATE	OPERATOR	
DAF influent	2026-07-26	Operator	

OBJECTIVE Plant operating points

This is a day of full-scale operation, not a bench session. Each "jar" below is a steady window of the DAF influent: a stretch where the feed rate and every dose held still, summarised to its median readings. The figures are the plant at its own residence time, which a beaker only estimates. No mixing protocol applies. The raw water analysis on this page is the facility's only analysis, taken 2026-08-25, AFTER the window - a placeholder until an earlier bottle is logged, not this water's fingerprint.

No fingerprint. The analysis above is not this water's own, so these windows are a record of what the plant did and never a match for another water: they do not enter Find chemistry. Log a bottle from this stream dated before the day and the windows will be re-joined to it.

THE DECISION

MUST MEET	RUN THIS	IT LEAVES
100.0 mg/L TSS · pH 6.5-9.0	Caustic soda 40% 34.85 mg/L + Ferric chloride 40% 286.79 mg/L Jar 6 of JT-0048 plant — lowest residual - no jar here is fully priced, so cheapest cannot be judged. Finished at pH 6.36.	58.889 mg/L TSS

How long it has to stand

This jar was not read repeatedly as it settled, so how long it needs to stand is unknown. The result below is the water at the moment it was sampled — on a plant with twenty to forty minutes of residence, which is the horizon that has to hold, not the next morning's.

Still untested

- Do not implement any of these programs based on this test, as the influent variability invalidates the comparison.
- Repeat the jar test on a single, well-mixed sample to establish a valid dose-response curve and confirm the ferric dose required to meet the 100 mg/L TSS limit.
- Ensure that final pH is adjusted to at least 6.5 and record settling times and sludge volumes to assess operational feasibility.

Everything after this page is the evidence for it: the water, every jar, the curves and the costs. Nothing here is a number that does not appear again below.

A plant day, as the operator sees it. The same report a bench session gets, headed as a day of full-scale operation: the stream, the decision built by the code from the windows, and a red notice that the analysis on the page is a placeholder, not this water's own.

RAW WATER ANALYSIS

pH	10.1	Conductivity (µS/cm)	—	Turbidity (NTU)	—	TSS (mg/L)	5137.46
Streaming current (SCU)	-269.48	COD (mg/L)	—	BOD (mg/L)	—	FOG (mg/L)	—
Alkalinity (mg/L CaCO ₃)	—	Total P (mg/L)	—				

THE WINDOWS

JAR	WINDOW STARTED	MINUTES	READINGS SUMMARISED	FEED (GPM)
1	2026-07-26 01:49	77	78	—
2	2026-07-26 03:07	43	44	—
3	2026-07-26 03:51	29	30	—
4	2026-07-26 04:21	71	72	—
5	2026-07-26 05:33	30	31	—
6	2026-07-26 15:25	35	36	—
7	2026-07-26 20:39	35	36	—
8	2026-07-26 22:17	30	31	—
9	2026-07-26 23:50	37	38	—

METERS AGAINST THE LAB

Meters unchecked. No bottle from this stream has been analysed on a plant day, so every figure above rests on meters nobody has held against the lab. Take a bottle on a plant day, log it on the stream with its time, and this table fills in.

CHEMICALS AT PLANT SCALE

PRODUCT	MEDIAN DOSE (MG/L)	PER 1,000 M ³	SPEND PER 1,000 M ³	USED PER DAY	SPEND PER DAY
Ferric chloride 40%	282	282 kg	not priced	—	—
Caustic soda 40%	34.9	34.9 kg	\$51	—	—
Programme			—		—

A dose in mg/L is grams per cubic metre, so product per 1,000 m³ is the dose in kilograms. The gateway published no feed rate for these windows, so kilograms and dollars a day cannot be given. The coagulant's own solids were 76.5 mg/L against 1860 mg/L removed: 4.1% more dry solids than the water gave up. Chemical spend only.

JARS

The next page. The windows with their start, length and the readings each summarised; the meter check standing unchecked, in red, because no bottle has yet been held against these meters; and what the plant used, per thousand cubic metres.

The window has to find its water

This is the part that is not plumbing. The lab analysis is the fingerprint of a water; the telemetry supplies operating points against that fingerprint. But nothing in a telemetry feed says which water it was treating, and a fingerprint is of a moment: the same plant's water in July is not its water in January. So the record needs one thing it did not have,

a stream. A stream is a monitoring point that persists, the DAF influent, the post-equalisation line, and both the lab samples and the plant days hang off it.

The join is then a rule about time rather than a foreign key. A window belongs to the most recent analysis on the same stream, collected at or before the window started, and not older than a staleness limit. The limit is the honest part. A six-week-old analysis is a reasonable fingerprint for a stable plant; a six-month-old one is not, and attaching it silently would put hundreds of confidently wrong rows into the matcher. Windows with no analysis in range are still stored, because they are a true record of what the plant did, but they carry no fingerprint and cannot be matched against, the same way a non-water sample already cannot. Their report says so in red. And because it is a rule rather than a key, it runs again whenever a bottle is logged: on the first stream brought in, the only analysis on record had been taken after the windows, so all seven days printed as placeholders, and will move to the right bottle the day one dated before them exists. Sampling the same stream again is what makes the seasonal drift visible, and that pays off on the bench too: once the samples carry a stream, the chemist can see that the water that took 300 mg/L of alum in January is not the one on the bench in July.

Turning a pump into a dose is the one conversion in the chain, and it is not optional even where the gateway publishes ppm. Litres per hour of product over litres per hour of feed is a volume ratio; times the density of the product as supplied it is milligrams per litre of product, which is the convention every bench jar uses. Pinning that down before the first row goes in matters more than it looks: a dataset that quietly mixes pump volume with product mass, or product with active ingredient, cannot be repaired later. The first device did exactly that, which is the last of the four things below.

What the feed actually says

Everything above was designed before a byte of telemetry had been read. The first pull from a pilot unit, two weeks of readings every five seconds, found four things the design had not. Each of them would have gone into the record as a fact.

- **A dose key is a setpoint, not a delivery.** One coagulant's dose key held a constant 100 ppm through a pilot in which that pump's flow was zero from beginning to end. The figure says what the operator asked for, not what went in. A chemical counts as dosed only when its pump flow is above zero.
- **A hard zero is a dropped sensor.** The outlet solids meter read exactly 0.0 for a third of the readings in the two days charted above. During those minutes the discharge turbidity ran from about 130 to 1,600 NTU: the water was visibly dirty and the solids reading had simply failed. Believed, that zero books 100 percent removal across a third of the dataset. So a zero on a solids, turbidity, conductivity or feed key is recorded as absent, and the window gets no removal figure rather than a flattering one.
- **A key that never moves is a stuck probe.** The streaming current channel returned exactly -500 for every one of a hundred thousand readings. That is the instrument's fault value. Stored, it would have put a fabricated charge reading on every window, and the matcher would have matched on it. Any key with no variation across a whole pull is dropped.
- **The ppm on the screen is a volume ratio.** Across two days of readings, the published ppm on every pump was pump flow over feed flow to three decimal places: microlitres of product per litre of water, not milligrams. For a 2 percent polymer near the density of water that is the same number, which is why nobody had noticed. For 40 percent ferric chloride at 1.42 kg/L it is 30 percent short on every window. So a dose is stored as the volume ratio times the product's density, as mg/L of product as supplied, and the density comes from

the catalogue or, where the row has none, from a published model of the solution that refuses outside its fitted range. The same figure then needs the strength to mean anything: 350 ppm of a 2 percent solution is about 7 mg/L of active polymer, an ordinary dose that only looks absurd until the strength is beside it.

None of these is a fault in the gateway. Each is a reasonable thing for a PLC to publish, and each becomes a wrong record only at the moment a window is written without the rule. Part one's lesson about prose was that a rule the model ignores needs a check the code can make. The same sentence holds for a sensor.

Plant windows are not bench jars, and must not pretend

Three things make a window weaker evidence than a beaker, and stating them before the data goes in is what keeps the dataset credible.

- **The dose was not chosen to be informative.** A bench ladder deliberately brackets the answer. A plant sits wherever the operator set it, so the rows cluster where things already work and say nothing about the edges, which is precisely where a model needs evidence.
- **Sensors are not laboratories.** An inline solids meter is a turbidity inference with a calibration date. It drifts, and it is rarely checked against a lab result. So every bottle the lab analyses from a stream is held against the meter of the plant day it was taken on, a timed bottle against the window it fell in: within a tenth is a fit, beyond that the meter is flagged for recalibration, and until a bottle exists the report prints *unchecked*, in red, on every plant day of that stream. The correction is computed and shown but never applied. Rewriting a window's outlet by a factor derived from two bottles is the kind of quiet adjustment that makes a dataset unrepairable.
- **Nothing is controlled.** An upstream production change moves influent and effluent together, and the window records it as if the chemistry did it.

So a window is marked as a plant result everywhere it appears: on the chart labels, in the product and approach rows, in the counts, and in what the model is told. It ranks and costs like a jar, because it is one, but it is never quietly mixed in, and a dose model should be able to weight it below a bench row.

The right first use of the plant data is not to train on it. It is to ask whether the plant agrees with the bench, and the rule for that is deliberately strict, because every loose version of it is the water talking: the same products, each dose within a tenth, the influent within five percent, both sides read at the plant's own residence time, and the gap judged against the bench's own replicate spread for that programme, since that is the only honest bound on how much of a difference is real. Where a window and a jar meet those terms, the window is a free validation of the jar test that chose the programme. Where they disagree, the disagreement is the next bench session, and the bench is the only place the doses the plant never visits can be tried. And where the plant ran something the bench never did, that is the finding. On the first stream brought in it was the whole table: the plant was running ferric chloride and the bench had run polymers. A column of plant programmes and not one pair, which is true, and exactly what the client needed to be told.

WHAT HAS BEEN TRIED HERE

Every chemical dosed across all 16 sessions, the range it was pushed over, and what that one product contributed to the cost – separated out from the programme total, because the cheapest coagulant does not always make the cheapest programme. Removal is TSS where measured, turbidity otherwise, and is the range seen across jars containing this chemical rather than anything it achieved alone.

CHEMICAL	JARS	DOSE RANGE (MG/L)	ITS COST (\$/M ³)	ALKALINITY TAKEN (MG/L)	REMOVAL SEEN
Flocculant F1	39	92.72 – 3047.73	0.029 – 0.941	0	69.9% – 99.9%
Ferric chloride 40%	29 29 plant	117.29 – 406.05	—	43.4 – 150.2	-29.3% – 97.9%
of which on the plant	29	117.29 – 406.05	steady windows of the full-scale unit; the row above pools them with the bench		
Cationic conditioner	16	107.23 – 758.11	0.139 – 0.986	—	73.5% – 99.4%
Polymer P-2	48	1.91 – 46.05	0.004 – 0.104	0	69.9% – 99.9%
Polymer P-3	5	2.96 – 50.5	0.007 – 0.117	0	81.0% – 99.9%
Polymer P-1	2	3.06 – 31.83	0.005 – 0.055	0	99.8% – 99.9%
Sulfuric Acid	59 4 plant	17.83 – 2426.23	0.009 – 1.230	16.94 – 2305	69.9% – 99.9%
of which on the plant	4	17.83 – 32.54	steady windows of the full-scale unit; the row above pools them with the bench		
Caustic soda 40%	42 42 plant	10.38 – 146.9	0.015 – 0.217	-73.45 – -5.19	-368.1% – 98.5%
of which on the plant	42	10.38 – 146.9	steady windows of the full-scale unit; the row above pools them with the bench		
Caustic soda 40%	8 8 plant	4.86 – 22.91	0.007 – 0.034	-11.46 – -2.43	-368.1% – 98.5%
of which on the plant	8	4.86 – 22.91	steady windows of the full-scale unit; the row above pools them with the bench		

What has been tried here, with the plant in it. Every product's row in the client's dossier pools bench and plant; the sub-row under it is the plant's windows alone, with their own dose range, so a bench best can never stand for what the plant did.

PROGRAMME ON THE PLANT	WINDOWS	LEFT (MG/L)	WATER IN	NEAREST BENCH RUNG
Ferric chloride 40% 276	3	1470 (861-1782)	3922	these products were never run together on the bench
Ferric chloride 40% 384	2	466 (119-814)	1962	these products were never run together on the bench
Ferric chloride 40% 290	2	2310 (2023-2596)	3578	these products were never run together on the bench
Ferric chloride 40% 206	1	1129	3707	these products were never run together on the bench
Ferric chloride 40% 178	1	1753	1480	these products were never run together on the bench
Ferric chloride 40% 313	1	2499	3250	these products were never run together on the bench
Ferric chloride 40% 257	1	2355	1822	these products were never run together on the bench
Ferric chloride 40% 287	1	58.9	2751	these products were never run together on the bench
Ferric chloride 40% 200	1	255	3119	these products were never run together on the bench

WHAT THE PLANT USED

From the windows on each stream: each product's median dose, and where the gateway published a feed rate, kilograms and dollars a day at the median feed over the windowed hours. The programme on the cover is priced at the same feed beside it, so the two spend figures are on the same water at the same rate.

DAF INFLUENT · 7 PLANT DAYS	MEDIAN DOSE (MG/L)	SPEND PER 1,000 M ³	USED PER DAY	SPEND PER DAY
Ferric chloride 40%	229	not priced	—	—
Caustic soda 40%	34.6	\$51	—	—
Sulfuric Acid	21	\$11	—	—
Caustic soda 40%	18.6	\$28	—	—
The plant's programme		—		—
The cover's programme, Sulfuric Acid 23.05 + Caustic soda 40% 38.73, at the same feed		\$69		—

No window on this stream carried a feed rate, so only per-1,000 m³ figures can be given. The coagulant's own solids: 1.8% on top of what the water gave up (39.9 against 2239 mg/L). Chemical spend only, at the prices on the last page.

Bench against plant. Every programme the plant ran that the bench never ran at that dose on that water, with what it left and the nearest bench rung. Below it, what the plant used: each product's median dose over the windows, and the cover's own programme priced at the same feed.

What each person gets from it

The operator gets the switch point confirmed. Part one's record says which programme passed on the heaviest water; the plant's own windows on the heavy days say whether the switch actually held at the plant's residence time, on the plant's own sensors, at the dose the pump was really running.

The engineer gets the design basis checked against the equipment. The bench read its jars at the plant's residence time; the windows say what the tank held in practice. Sludge production from the plant's real dose over a real month is a haulage figure the bench could only estimate.

The chemist gets the plateau. Pooled dose-response curves across bench and plant show where a coagulant stopped buying anything, and the gaps list now includes the doses the plant has never run.

Since part one: three things the record now works out

Part one ended with a longer checklist as the shape of the work. Three items on it closed while this part was being written, and each is a figure the record used to carry as a typed constant, a verdict or a refusal, and now works out from the water.

- **The alkalinity budget became a pH.** Part one priced a coagulant's appetite for buffer with a factor per product: 0.92 milligrams of alkalinity per milligram of ferric chloride, 0.50 for alum. The record now rebuilds the water from its own analysis, hydrolyses the coagulant in it, lets the hydroxide settle out and reports where the pH lands, closed to air as the bench figure and with the carbon dioxide stripped as the ceiling a DAF approaches. From there it titrates the caustic or acid a target pH needs, in milligrams per litre of product at the catalogue price, which is the figure the recommendation sheet used to print as "required and unpriced". It refuses a water whose alkalinity was never measured, because that is the number that governs, and it refuses a product whose chemistry nobody has

written down. The first time the factors were derived from balanced reactions instead of typed in, two of the typed ones were out by exactly a factor of two. No jar on record had used either product. The check that would have caught them exists now.

- **A fitted endpoint carries its interval.** Part one's settling curves said whether the readings reached far enough down the curve to fix the endpoint. That is one question. How well they place it is another, and the fit now answers both: an endpoint on the report reads 180 ± 10 rather than 180, and a wide interval on an established curve is a reason to read the jar again. On every curve on record the refinement moved no endpoint by more than two percent of its fall, so the reports kept their figures and gained a margin.
- **A name typed two ways is one product.** The catalogue once grew seven duplicate products in a day, two of them priced per kilogram beside their per-pound twins, because a chemist typed one trade name four ways. Names are now matched by similarity, at a cutoff high enough that two products a digit apart stay apart, and a match is proposed to the person reviewing the import rather than written by the importer. The same leniency reads a lab's "Alkalinty" as the parameter it plainly means, says so beside the value, and never merges nitrate with nitrite.

None of the three is a model. Each is the record doing arithmetic it could not do before, which is where part one said the work was.

Where the model stands, again

The rules from part one do not change. The model never transcribes a number; the windows arrive as rows, not as prose. The decision page is arithmetic built from the record, and a plant window can sit on the Pareto front beside a beaker. Every figure the assessment quotes beside a window has to be that window's own, and the payload tells the model which rows are plant and which are bench, so a sentence that compares them has to say so. A ratio between a plant window and a bench jar on

different waters is refused for the same reason a ratio between two beakers on different waters is: it is the water talking.

The plant is the largest jar in the set. It is not a better one.

The windowing thresholds were set the only way they can be, beside a DAF on a customer's site with a laptop, watching the windows form against a real influent. The plumbing was the easy part. What the plant data is for, in the end, is the same thing the jars are for: a record that lets the operator, the engineer and the chemist read the same page, with the plant's own hours on it.

The post that carries it

LinkedIn shows about three lines before "see more". The first sentence has to do the work.

A running DAF is a jar test that never stops. It publishes everything the bench writes down, and for years it went to a dashboard.

Part two of two. How the telemetry becomes a record instead of a chart: one steady-state window as one jar, the exact mapping onto the bench, the stream that ties a window to the lab analysis of the water it was treating, and the four things the first pull found that would each have gone into the record as a fact. A dose that was a setpoint. A solids meter reading zero on visibly dirty water. A charge probe stuck at its fault value. And a ppm that was a volume, not a mass. The plant is the largest jar in the set. It is not a better one.

[#wastewater](#) [#DAF](#) [#IIoT](#) [#jartesting](#) [#watertreatment](#) [#ThingsBoard](#)
[#processengineering](#)