

Advanced mixing for mineral-based materials

Shorter mixing time · no wear · minimal frictional heat · easy cleaning/change-over



Trajectory mixing: mixing at the push of a button



Programmable trajectory curves

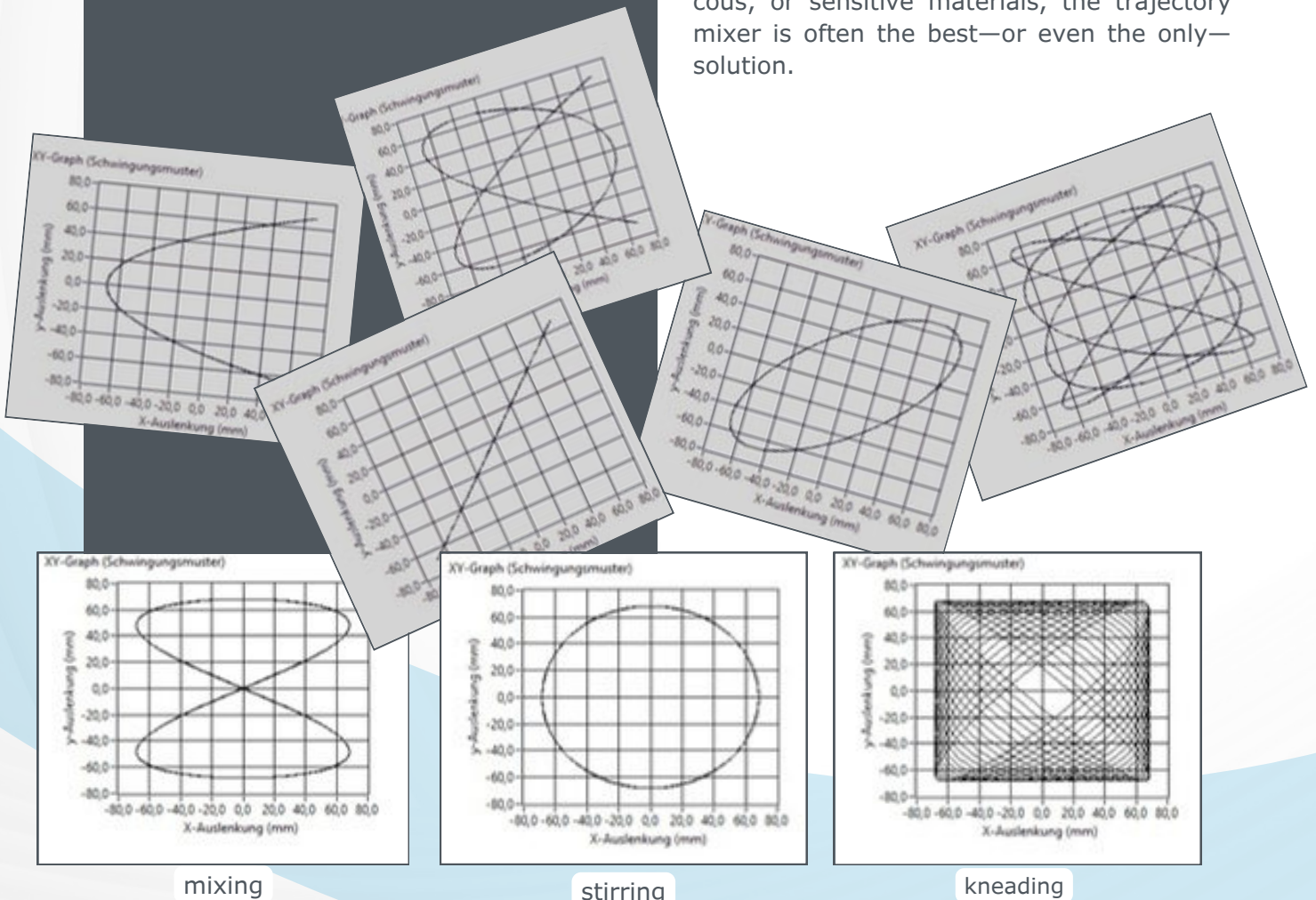
The trajectory mixer sets new standards in mixing. The process uses programmable trajectory paths along which the material is moved at high frequency within a hermetically sealed chamber. These highly complex motion patterns—so-called Lissajous figures—create a kind of “predefined roller-coaster ride” that generates intensive shear forces and enables uniform yet gentle mixing.

Without stirring or kneading tools

In its standard configuration, the system operates without mechanical stirring or kneading tools, replacing conventional agitator types such as whisks or kneading hooks with freely programmable motion profiles. By eliminating mechanical tools, the risk of over-processing and contamination is significantly reduced.

Mixing of substances by shear forces

Trajectory mixing is distinguished by its versatile applicability to solids, liquids, and gases. In particular, for abrasive, highly viscous, or sensitive materials, the trajectory mixer is often the best—or even the only—solution.



High mixing quality - stirrer-free and in seconds

No stirring tools

- The trajectory mixer operates without stirring tools.
- The wide range of complex mixing maneuvers is realized through trajectory paths.
- Making the process particularly low-wear.

Homogeneity

- Mixing parameters can be optimized for improved homogeneity.
- Improved mechanical strength.
- Vacuum operation possible for even greater homogeneity.

Mixing time & maneuvers

- Gentle mixing is possible.
- Mixing time is reduced to seconds.
- No separate dry-mixing process is required, as the mixing steps seamlessly transition into each other.

Cleaning/Change-over

- Easy cleaning of container
- Change-over in seconds (by changing container)
- Focus on your production - not on cleaning

Temperature

- No overheating due to the fast, low-friction process.
- Better control over binder activity.
- No thermal impact on mechanical properties.



Mixing container: low wear - fast change-over and cleaning

One vessel, one mixing process

The dry mixing of refractory raw materials takes place in a single step. Thanks to the high flexibility of the trajectory mixer, this step can be easily and efficiently integrated directly before wet mixing—ensuring a consistently optimized production process.

Vessel
also available
with ceramic
coating.



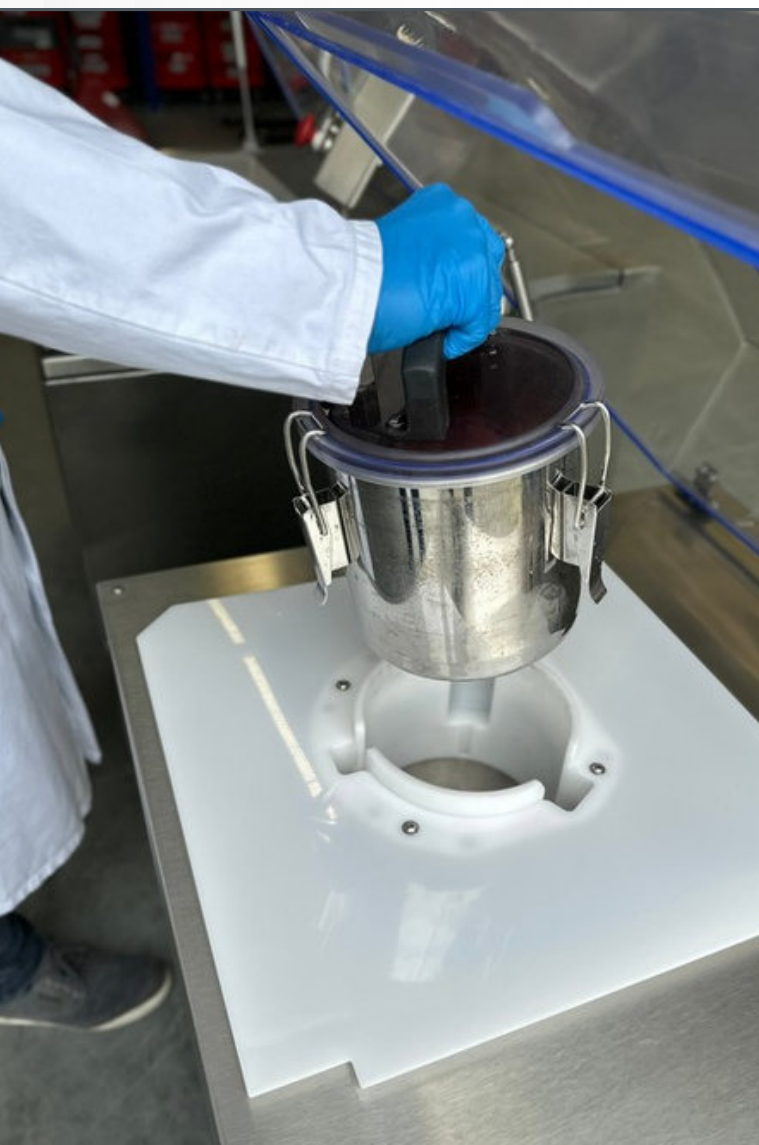
Dosing



Dry and wet
mixing

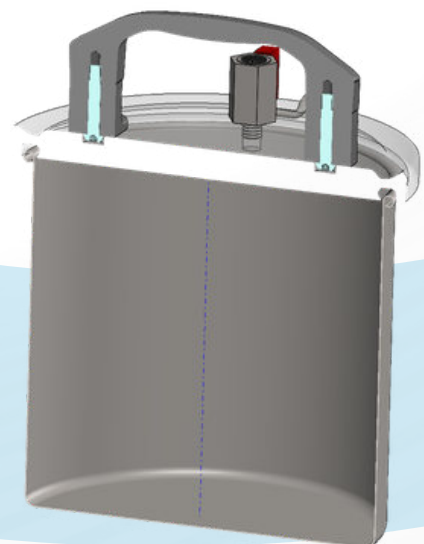


Further
processing



Only the vessel, no stirrer

The innovative, agitator-free mixing concept reduces contact surfaces within the system—and thus also abrasion on both the granules and the vessel. Even highly abrasive, coarse-grained formulations largely mix on their own, while the mechanical stress on the vessel remains low. The result: minimal wear, maximum granule integrity, and high process cleanliness—for consistent quality and longer service life in refractory production.





K1 - Trajectory mixer for R&D, laboratory and small series

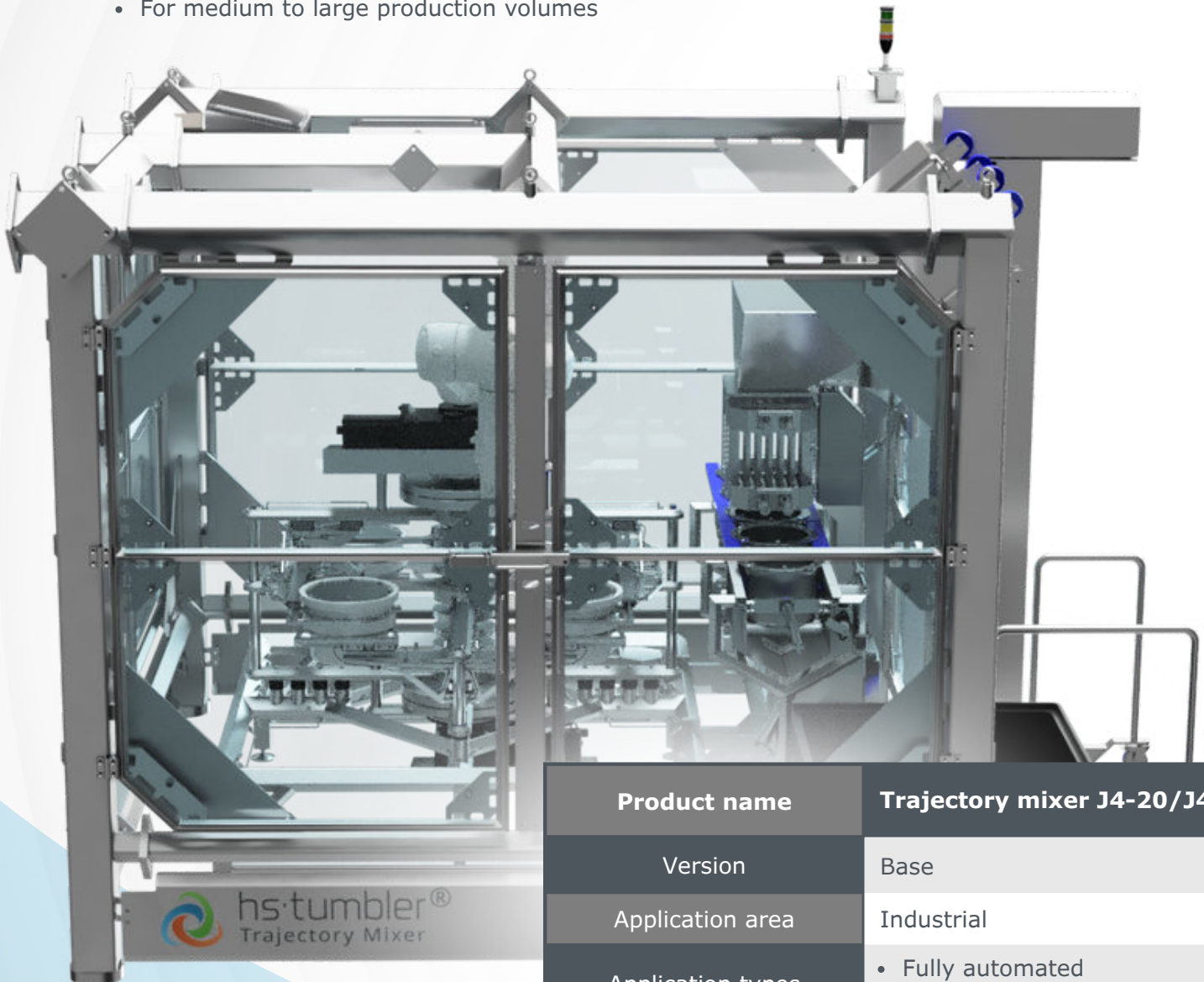
- Up to 4/7/11/15 liter per batch, interchangeable vessel for format changes in seconds
- Optional: Thermo module (add-on)
- Ideal for product and process development, pilot plants, and small series
- Scalable: Results and processes can be transferred to the J4 with minimal adjustments
- Shorter process times while maintaining consistently high quality



Product name	Trajectory mixer K1
Application area	Craft, research & development
Use	Standard and special vessels
Number of vessels	1 interchangeable vessel
Capacity	4, 7, 11 or 15 liters per batch (gross) - depending on machine execution
Dimensions	0.8 m × 0.8 m / 1 m × 1 m

J4 Base - Trajectory mixer for industrial use

- Fully automatic vessel loading, four integrated containers of 20/50l each
- Filling station for dry and liquid ingredients
- Robotic exchange of vessel
- For medium to large production volumes
- Direct scaling from K1 to J4 with minimal adjustments
- Significantly reduced process time while maintaining consistently high product quality



Product name	Trajectory mixer J4-20/J4-50
Version	Base
Application area	Industrial
Application types	• Fully automated • Manual
Maximum throughput	• app. 2.000 kg/h (J4-20) • app. 5.000 kg/h (J4-50)
Use	Integrated vessel
Number of vessels	4
Capacity	up to 20/50 l per vessel
Dimensions	app. 3.8 m x 3.8 m

Trajectory mixing for refractory materials - overview of applications



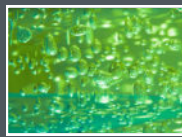
High-viscosity masses



Powders, and granular materials



Slurries and plastic compounds



Liquids and suspensions



High-viscosity masses

For pasty, highly viscous refractory masses, the process enables short and reliable processing cycles.

- Simultaneous wetting, incorporation, and homogenization throughout the entire vessel volume
- Significantly reduced processing times without heat input or material alteration
- Process reliability even with increasing viscosity; no “locking up” as can occur with conventional agitators
- Gentle handling of sensitive binders

Slurries and plastic compounds

For slurries and plastic formulations, the technology ensures quickly produced, consistently homogeneous systems.

- Rapid suspension formation with reproducible quality
- Flexible addition of multiple components without a fixed sequence; fewer dosing and operating errors
- Reduced cleaning effort due to the elimination of pre- and intermediate mixing steps
- Long-term stable distribution of fine particles; reduced sedimentation and agglomeration



Powders, and granular materials

Powders, mixed grains, and lightweight fillers are evenly distributed in a very short time—without any dead zones.

- Fast, complete homogenization of the entire material volume
- Minimized risk of segregation; no local over-stressing
- Gentle handling of fragile additives; smooth **trajectory paths** for sensitive materials



Liquids and suspensions

Liquid binders, dispersions, and slurries can be homogenized immediately and completely.

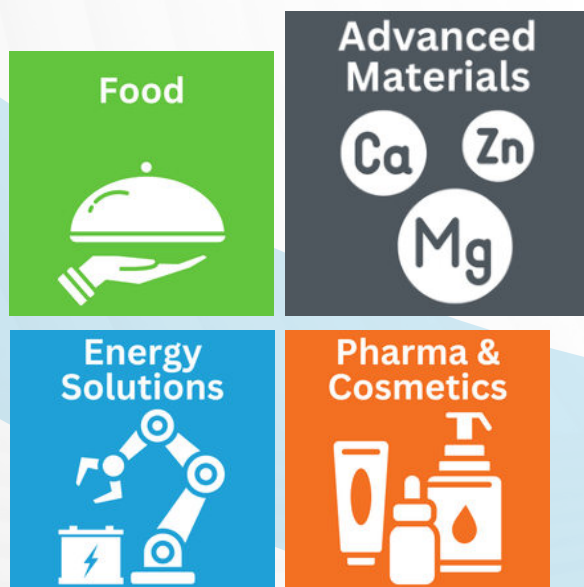
- No sequential addition required; stable distribution even of the finest components
- Shortened process times, with no local vortices or hotspots

Process-plus

- Optional: vacuum, temperature control, dosing and process accessories for optimal parameters
- Contactless mixing without agitators: lower wear, less cleaning, high process cleanliness



Overview of industries



Extras and accessories

Containers and lids in application-specific designs

The design and surface structure of mixing containers have a decisive impact on the shear behavior of refractory masses. Together with the process parameters, they play a key role in determining the homogeneity and particle distribution of the final product. For casting masses, tamping, and dry mixes, we design specifically optimized container geometries that create consistent conditions and ensure meaningful results. Upon request, containers can be equipped with wear-resistant, low-contamination linings (e.g., ceramic) to minimize abrasion and maintain chemical purity.



HMI

The modern HMI enables simple and precise control of all relevant process parameters – from mixing speed and curve profiles to mixing time. Product-specific programs for casting, tamping, and sprayable masses can be conveniently stored, managed, and recalled at any time, supporting reproducible results and efficient batch changes.

In addition, the HMI offers features such as multi-level user management, password protection, logging of operating data, and error messages in plain text.



Vacuum unit - for maximum product quality & process reliability

If you want to reliably avoid air inclusions, reduce oxidation, and achieve a particularly dense, homogeneous product mass, the use of an optional vacuum unit is recommended. Evacuating the process container not only significantly improves mixing quality but also expands the application range of the trajectory mixer, especially for low-cement casting masses, plastic masses, or reactive sol-gel systems. The result: lower porosity, higher green density, and reproducible packing.

This not only ensures high process reliability but also meets requirements for traceability and quality assurance in refractory applications.





About hs-tumbler

hs-tumbler GmbH is an innovative mechanical engineering company based in Quakenbrück, Germany. With a dedicated team of 15 employees, the company develops and produces state-of-the-art trajectory mixing systems for demanding applications across a wide range of industries.

The inventor of the trajectory mixer and managing director, Bernhard Hukelmann, personally stands for the company's technical excellence and innovative strength. hs-tumbler combines practical solutions with forward-looking technology – Made in Germany.

Services

- **Product Testing:** We process your product in our laboratory so you can see the possibilities of trajectory mixing for your material.
- **Parameter Analysis:** We determine the optimal mixing parameters for your product (curve profile, speed, etc.).
- **Container Optimization:** We develop the suitable container (shape, material, surface) for your product.
- **Training:** We train you and your team in the proper operation of the trajectory mixer.
- **Maintenance and Repair:** Fast service by experienced technicians – reliable and competent.



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