



DENA NANOMETRIC MANUFACTURING TECHNOLOGY & ADVANCED PROCESS INTENSIFICATION

Background

- DENA System are more far advanced compared to conventional mixing and homogenising methods. The system now performs the processes of: -
 - Mixing
 - Blending
 - Homogenising
 - Emulsifying
 - Shearing
 - Shattering
 - Milling/reducing
 - Reactions
 - Dispersing
 - De-agglomerating
 - Polishing
 - finishing/shaping any Particulate
- DENA system is capable of carrying out all these processes in one single continuous process line Vs conventional methods, which require several pieces of equipment

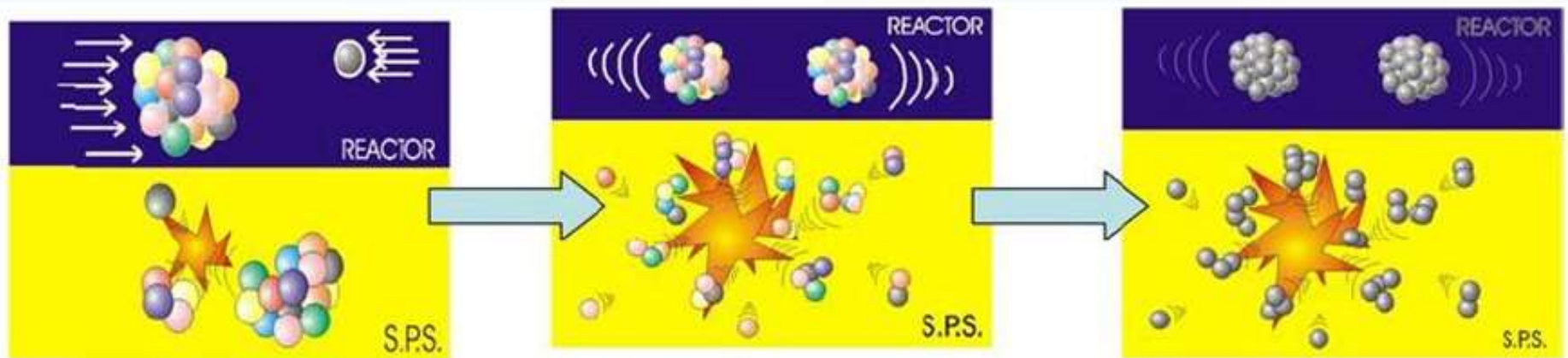
Dena Technology - Patented Design

- There are far more elements (functional heads) inside a DENA reactor. This results in many more streams of material inside the reactor and, therefore, far more inter-particle impact resulting in a narrower size distribution once a material is processed.
- When the material velocity increases, and the flow becomes turbulent, the elements vibrate and flex in certain ways and angles. This action is an extremely precise application of energy, created by the material flow, on a micro processing level. It is this process which allows DENA reactors to produce such impressive quality.



DENA S.P.S Vs Bead Mills

- Traditional bead mills are not pressurised. During the milling process, a circular motion created within the bead mill causes both the beads and the process material to scrape round the mill body. Contamination is introduced into the process material from both the mill and the paddles. In addition, the contamination is also introduced from the bead materials (grinding media) as the beads wear out.
- The DENA S.P.S. mill reactor uses a different operating principle which considerably reduces wear and tear on the components, which are in direct contact with the material and almost totally eliminates contamination.



Comparison with conventional Milling equipments

- DENA System can be adapted to run on either batch or continuous processing modes and yields better throughput rates compared with conventional milling equipments:

EQUIPMENT	BATCH SIZE	PROCESSING TIME	THROUGHPUT	RATE
Ball Mill	400 litres	26 hrs	0.16 litres/min.	10 litres/hour
Bead Mill	400 litres	1 hr.20 mins	5.00 litres/min.	300 litres/hour
Basket Mill	400 litres	3 hrs 45 mins	1.77 litres/min.	375 litres/hour
DENA Batch	400 litres	1 hr.6 mins	6.00 litres/min.	360 litres/hour
DENA continuous	400 litres	20-40 mins	10-20 litres/min.	600-1200 ltr/hr

Technology Advantage - 1

Faster processing

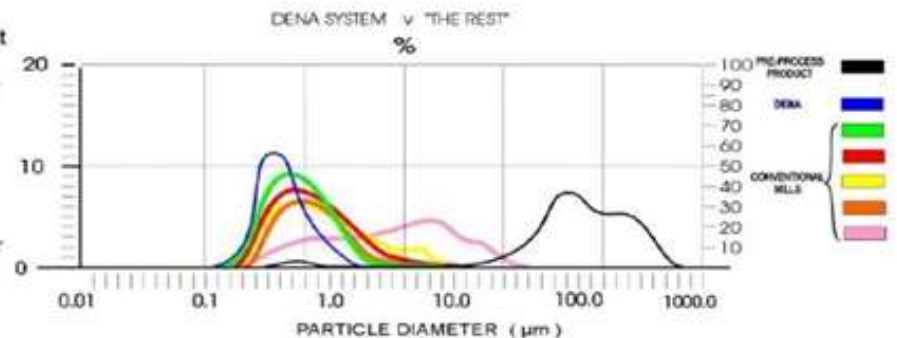
- The two photographs below illustrate the substantially reduced mixing time with no loss of quality when using the Dena system on a high viscosity suspension



Conventional High Speed Mixer and Ball Mill
Total mixing time for full batch - 32 hours

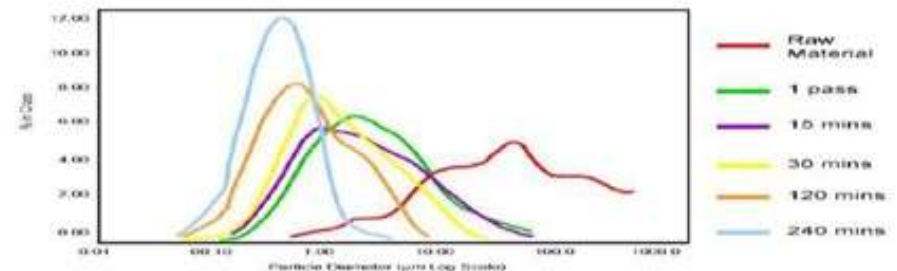
Greatly Improved Homogeneity

The chart on the right plots the distribution of processed particle size by percentage. The narrow and tall bell curve illustrates the superiority of DENA system's process over conventional mills for better homogeneity.



Greatly Improved Particle Size Consistency

Each pass through the DENA system process will reduce the larger particles to a uniformly smaller size as illustrated on the chart on the right.



DENA System
Total mixing time for full batch - 1 hours

Technology Advantage - 2

Finer Particle size

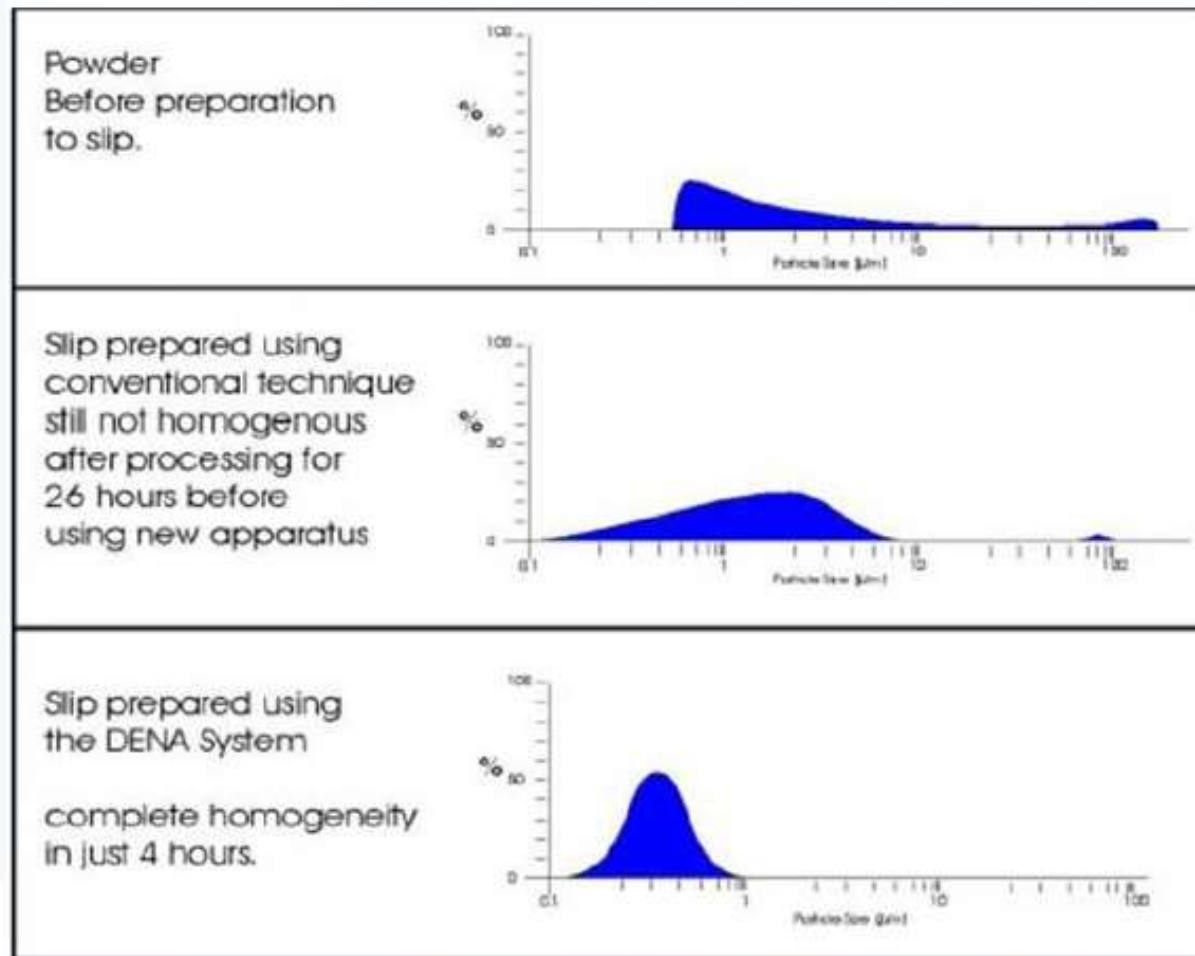
- The Dena system delivers finer particle sizes within a shorter period; the photos compare the sectional cuts across a sample processed using conventional techniques and the Dena system.



Technology Advantage - 3

Narrow Particle Size Distribution

- The three graphs below compare the extremely narrow particle size distribution attainable using the Dena system:



Other Technology Advantages

- Able to process any aqueous or organic liquids, polymers and even solids to complete homogeneity within hours.
- It handles material with initial particle sizes of more than a thousand microns and viscosity up to 4000 poise.
- Its processes do not affect the physical or chemical reactions of the materials being processed.
- Materials flowing through DENA system are processed in a completely enclosed conduit. The enclosed environment precludes material contamination and removes the need for 'clean-room' facilities.
- Cutting-edge technology of DENA offers its users precision control over the size of the particulates in their products. DENA customers typically use this technology strategically to refine the quality and efficiency of their existing products.

Technology Benefits

Reduced Mixing Times:

- Whilst a conventional mixing device typically takes up to 24 hours to handle a mixing task, the DENA System reduces this to 4 hours or less due to the precise application of energy to the material.

PRODUCT	CONVENTIONAL METHODS	DENA SYSTEM
Pharmaceutical	7 days	2 hours
Paint	32 hrs	1 hour
Jet black ink	10-60 hrs	2-3 hrs
Very fine dyes	72 hrs	1-2 hrs
Dielectric superconductors	48 hrs	10 mins
Ceramic enamels	44 hrs	2 hrs

Technology Benefits (Contd.)

Quality Improvement:

- Material is processed in a fully enclosed conduit and cannot leave the machine without being completely processed.
- This precise application of energy to the material results in far better homogeneity in the processed material.

Reduced Energy Cost:

- Energy output is reduced dramatically (by more than 10 times) by using energy more efficiently than conventional systems.
- Every system is custom designed using a computer-based laser technique to match the amount of energy applied with the viscosity, solid content and specific gravity of the materials to be processed.

Reduced Operator Costs:

- Simple 'pumping through' cleans up the machine quickly thus, enabling more batches to be processed within each 24 hour work cycle.

Technology Benefits (Contd.)

Operator Safety:

- The Dena system is totally enclosed, so human operators are protected from the material being produced.

Contamination Free Production:

- Being totally enclosed, 'clean room' environment are not required, reducing facility costs dramatically.

Double Tasking:

- The DENA Reactors can be heated up or cooled down to act as a reaction chamber as well. This feature is particularly applicable for the Pharmaceutical, Chemical and Food industries.

Processing Speed Comparisons:

- Processing time depends on the number of mixing stages, number and speed of passes within each stage, the length of the setup procedure, the length of the cleaning cycle and reset. The following table indicates measured examples of batch processing.

Standard laboratory units

- Laboratory Scale Systems are issued mainly for product development. The reactor modules are designed to be easily changed to accommodate new formulations and product. This can be set up with two of three different reactors connected in parallel and using valves to select the required reactor or, simply changing over the reactors with quick release fittings.



DM-100 Series

Sample Capacity :	75ml to 150 ml
Maximum working pressure:	2bar
Sample viscosity limited by the peristaltic pump pressure	
Reactors:-	
D-Mi₁	De-agglomeration - Reactors are designed mainly to de-agglomerate powder in suspensions (liquids) and to mix all ingredients uniformly.
S-Mi₁	Homogenising - Reactor is designed to homogenise and disperse all the product/samples ingredients. They also give a constant particle size to processed material.
SPS	Particle Size Reduction - Reduces particle size of material further and polishes rough edges of shattered material.
SPS Mill	
Chamber Volume:	100ml(cc)
Grinding media:	Ceramic beads
Volume:	82 to 85ml
Sizes (diameter):	0.3mm to 1.0mm (0.2mm beads in future)
Power Supply:	240v AC (UK)
Air supply:	2bar
Only a small amount of product is needed for a sample run, air is used to purge/empty all the sample from the system prior to cleaning	

Standard laboratory units (contd.)

DS-100 Series



Sample Capacity :	500ml to 1000 ml (can be modified to 3000ml)
Maximum working pressure:	6bar

Viscosity of sample is limited by pump pressure

Reactors:-

D-Sa₁ De-agglomeration - Reactors are designed mainly to de-agglomerate powder in suspensions (liquids) and to mix all ingredients uniformly.

D-Sa₃ Homogenising - Reactor is designed to homogenise and disperse all the product/samples ingredients. They also give a constant particle size to processed material.

SPS Particle Size Reduction - Reduces particle size of material further and polishes rough edges of shattered material.

SPS Mill

Grinding media	Depends on processed material
Volume:	830ml to 860ml
Sizes (diameter):	0.1mm to 5.0mm

The initial particle size of the sample will determine the bead size required.

Power Supply:	415v three phase
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Air supply:	6bar
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Overall dimensions:

H x L x W =	630 x 1050 x 590mm
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Pilot scale units

- These custom designed systems are intermediary scaled units to cater for small production volume as well as to use for efficiency testing before full scale production.

DS-200 Series



Sample Capacity : 200 to 300 ml/ min	
Maximum working pressure: 6bar	
Sample viscosity limited by the pump pressure	
Reactors:-	
1 no.	D3 & D4 (De-agglomeration) Mainly to de-agglomerate powder in suspensions (liquids) and to mix all ingredients uniformly.
2 no.	SPS (Particle Size Reduction) Reduces particle size of material further and polishes rough edges off shattered material.
1 no.	S1 (Finishing & Homogenising) Homogenise and disperse all the product/ samples ingredients and to give constant particle size to the processed material.
SPS Mill	
Grinding media:	Depends on material
Volume:	830 to 860ml
Sizes (diameter):	0.1mm to 5.0mm
Initial particle size of the sample will determine the bead size required.	
Power Supply:	415 Three Phase
Air supply:	2bar
Air is used to purge/empty all sample/product from the system prior to cleaning	
Overall dimensions:	
H x L x W =	1800 x 1700 x 1155mm

Pilot scale units (contd.)

DS-300 Series (Mill Unit)



Sample Capacity : 200 to 800 ml/min (single pass)
Maximum working pressure: 6bar

Viscosity of sample is limited by pump pressure

Reactors:-

- 1 no. **D3, D4 & D5** (De-agglomeration)
Mainly to de-agglomerate powder in suspensions (liquids) and to mix all ingredients uniformly.
- 3 no **SPS** (Particle Size Reduction)
Reduces particle size of material further and polishes rough edges of shattered material.
- 1 no. **S1** (Finishing & Homogenising)
Homogenises and disperse all the product/ samples ingredients and to give constant particle size to processed material.

SPS Mill

Grinding media Depends on material
Volume: 1065ml to 1090ml
Sizes (diameter): 0.1mm to 5.0mm

Initial particle size of the sample will determine the bead size required.

Power Supply: 415v three phase
Air supply: 6bar

Air is used to purge/empty all sample/product from the system prior to cleaning

Overall dimensions:

H x L x W = 1900 x 1600 x 1055mm

Production scale units

- These systems are purpose built. They can incorporate two separate processing lines which can be used jointly or separately (to produce different products) these machines are computer controlled and offer manufacturing flexibility, precise product quality while saving on the extra supervision required in conventional methods



Sample Capacity :		1000 to 5000 ml/min standard Can be modified up to 7000ml/min
Maximum working pressure: <i>(Viscosity of sample is limited by pump pressure)</i>		6bar
Reactors:-		
5 nos.	2 no. D3 , 2 no. D4 , and 1 no. D5 (De-agglomeration)	Mainly to de-agglomerate powder in suspensions (liquids) and to mix all ingredients uniformly.
5 no.	SPS (Particle Size Reduction)	Reduces particle size of material further and polishes rough edges of shattered material.
1 no.	S1 (Homogenising)	Homogenises and disperse all the product/samples ingredients and to give a constant particle size to processed material.
SPS Mill		
Grinding Media		Depends on processed material.
Volume of beads		approx. 9.5litre
Sizes (diameter):		0.1 to 5.0mm
Initial particle size of the sample will determine the bead size required for the first SPS Mill..		
Power Supply:		415v three phase
Air supply:		6bar
Air is used to purge/empty all sample/product from the system prior to cleaning		
Overall dimensions:		H x L x W = 1900 x 2500 x 1900mm

Global Clients of Dena Technology



BASF



3M Worldwide



Application - Paints & pigments



At the Operation Level the Dena System has many distinct advantages over conventional systems.



Application - Paints & pigments

- Advantages over conventional systems:
 - Consistent Quality
 - Repeatability
 - Finished Product at room or any desired temperature
 - Colour Selection between batches
 - Multi-function System Processing
 - Approximately 1/3rd size of Conventional systems
 - Separate flushing/cleaning cycle using either heat and/or detergent and/or steam
 - Cost Effectiveness
 - Reduction of waste
 - Savings in time, energy, labour and space
 - Water-based paints, emulsions and glosses produced in one machine
 - Additional Dilution and Filtration In-Line
 - Zone 1 Machine (flameproof)
 - Milling Process
 - Pigment Dispersion
 - Uniformity of colour mix
 - Narrow Particle Size Distribution
 - PLC Controlled Machine
 - Competitive Price

For Further information
Visit www.dena.co.uk