

# Complete lines for processing wood plastic and natural fiber composites

Application: Composites

**Sustainable  
Solutions  
Worldwide.**

battenfeld-cincinnati 

## **Process engineering for efficient plastics extrusion of tomorrow – From the raw material to the finished product**

Based on our modular line concept, we are able to implement cost-optimized and customer-specific solutions. This goes beyond the product specification to the processing of the materials, the infrastructure specified in the general conditions up to the appearance of the plant and the control interface. Our company takes all of these conditions into account when designing your extrusion line. We combine our own products with components from long term partners in order to supply our customers the ideal solution from a single source.

### **battenfeld-cincinnati extrusion lines – One-stop solutions**

1

- Customer expectation
- Plant specification
- Specifications
- Resource check

2

- Technical clarification
- Specification sheet
- Production of machines
- Selection of suppliers
- Supplier coordination

3

- Manufacturing
- In-house testing
- Pre-commissioning
- FAT on request

4

- Line commissioning
- Line handover
- Process consulting
- Staff training
- After Sales Service

### **Conservation of resources while maintaining profitability – Sustainability all along the line**

Our solutions offer a resource-saving and economical production of your products and our worldwide service network ensures the constant process availability. We focus on highest product quality with high output rates, functionality, machine availability as well as energy saving.



## Complete lines for processing composites – Wood plastic composites and natural fiber composites

Regardless of which product has to be manufactured, battenfeld-cincinnati offers you the appropriate line. fiberEX extruders are used in lines for the production of wood plastic composites as well as for natural fiber composites.

The fiberEX extruder series was designed especially for the production of wood plastic composites (WPC) and natural fiber composites (NFC). With an output range of 30-1,000 kg/h, the machine series exactly meets the requirements of the WPC/NFC industry for maximized process stability for all output ranges. Based on its long-term expertise, battenfeld-cincinnati offers solutions to process a wide variety of raw material combinations. Maximized flexibility is ensured by a modular extruder concept for direct extrusion as well as the two-step production process.

### Advantages

- Expertise gained from more than 260 lines placed worldwide
- Modular machine concept for direct extrusion as well as extrusion in the two-step process
- Partnerships with leading system suppliers in the market along the whole supply chain
- Enhanced lifetime of screws and barrels
- Complete solutions from the formulation development to equipment design

The fiberEX extruder series is built and designed in Vienna/ Austria, at the group's competence center for counter-rotating twin screw machines.

At battenfeld-cincinnati a team of specialists is dedicated to continuous, targeted product and process improvement. Together with its worldwide network of competent partners specialized in raw materials, formulation development, tooling, as well as feeding and dosing solutions, battenfeld-cincinnati is able to give the best possible support to start-ups and for successfully running a WPC/NFC extrusion business.

### Our offer

- fiberEX extruder series with screw diameters from 42-135 mm for outputs from 30-1,000 kg/h
- Diverse screw geometries for processing WPC based on a variety of different raw materials and their combinations
- Modular dosing and feeding solutions for all materials, including bulk materials with low or varying bulk density or poor flow behavior
- Optimized degassing solutions to maximize the achievable processing window
- Diverse metallurgical solutions for wear protection with in-house technology

## Complete lines for processing composites – Composite product areas and markets

NFC are composite products consisting of natural fibers, mainly thermoplastic polymers and additives to improve and tailor the required properties to the end application. WPC is a sub-category of NFC, indicating that the fiber originates from a wood source. Formulations using more than 20% fiber be considered as WPC/NFC (in terms of processing equipment).

WPC/NFC end products are often a substitute for wood products, but are beginning to come into their own on the international market. 75% of the total market volume is still found in the outdoor sector, although indoor applications are gaining in importance.

### Outdoor applications

- Decking, railings and barriers
- Fencing and siding
- Noise barrier panels and sight screen shades
- Housing and shelter systems

### Advantages

- Splinter-free, slow fading or colorfast
- Flexible design and surface structure
- Resistant to moisture and organic attack
- Low thermal expansion and weather resistance

The biggest and most established market is North America where WPC/NFC products have a long tradition and therefore higher acceptance. In Europe, the market first took off in 2003, when a volume of over 40,000 tons per annum was reached. In Asia, there are well-known markets like South Korea and Japan with an established market acceptance of fiber composites. China also shows dynamic growth and a high number of new applications.

### Indoor applications

- Doors and door frames
- Furniture and skirting
- Window sills and decorative sheets

### Advantages

High acceptance in hot climates with high humidity, where MDF is not suitable.

The markets in Europe and North America are stable with high innovative strength and are seeking new applications, while in South America, Australia and Africa there are minor market volumes yet and relatively moderate innovative drive. battenfeld-cincinnati has served the WPC/NFC industry right from the start, and has designed fiberEX, a machine series tailored to meet specific processing challenges of this material group.



# Complete lines for processing composites – Formulation of components

The limiting factor in the choice of polymers is their melt temperature which should not exceed 200°C to avoid fiber degradation or burning. Recycled grades of polymers can be used as well, depending on their availability and quality/purity. To tune the mechanical and physical properties to the desired application, a variety of additives are available. This is why WPC/NFC formulations always have more than two (up to ten) components, depending on the complexity of the specifications or end products.

## Formulation

Formulation mainly consist of two components:

### 1. Natural fibers

All fibers available throughout the year in a constant quality; these normally represent the larger proportion (in terms of percentage by weight)

### 2. Polymers

These essentially act as the “glue” between the fibers. Apart from very few exceptions, PP, PE and PVC polymers are used for WPC/NFC formulation.

## Project plan

To ensure a high quality end product and a lean process, the following three key project phases are recommended for an initial investment:

### 1. Exact product definition

- Product placement in the market
- Specifications of mechanical, physical properties

### 2. Formulation development

- Based on the requirements under point 1

### 3. Equipment

- Line design for the formulation under point 2

## Possible components

### Natural fibers

- Wood, rice husks, palm, cork, etc.



### Additives

- Lubricants
- UV-stabilizers
- Coupling agents, colorants, etc.



### Polymers

- PP, PE, PVC (virgin or recycled)



### Fillers

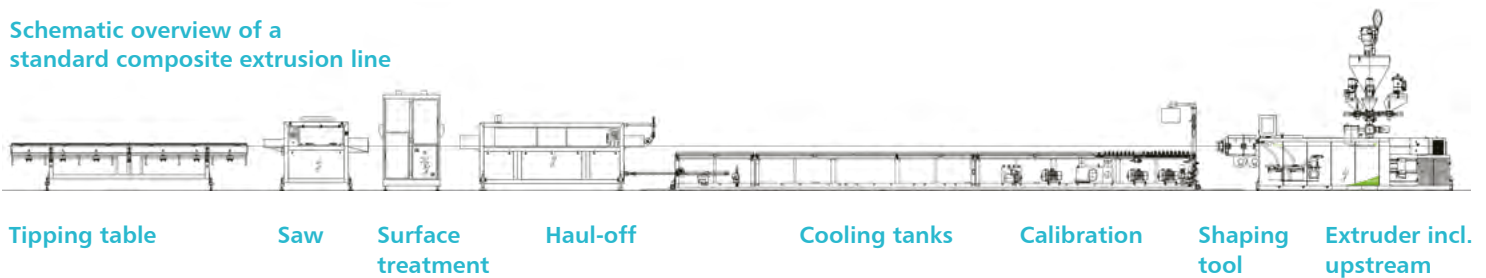
- CaCO<sub>3</sub> (calcium carbonate), talcum, etc.



Various components

# Complete lines for processing composites – Line design for excellent composite production

Schematic overview of a  
standard composite extrusion line



## Upstream

- When conveying WPC/NFC materials, it is crucial to avoid any segregation of the material blend
- Gravimetric dosing unit has to be designed for WPC/NFC formulations and to compensate the fluctuating bulk density and poor flow behaviors
- Extensive network of sub-suppliers

## Extruder

- The extruder's task is to process the material gently to avoid fiber degradation
- The extruder must provide the best possible melt quality for shaping the product

## Tooling

- The tool's task is to shape the melt to an end product with defined dimensions within tolerances, and with the desired surface quality

## Downstream calibration & cooling

- Compared to other extrusion processes, WPC/NFC do not have to be calibrated extensively

## Surface treatments

- Brushing (predominantly in Europe and Asia)
- Sanding (mainly in Japan)
- Embossing (predominantly in the USA and China)
- At battenfeld-cincinnati, co-extruded surface finishes are supplied by competent specialist partners
- Cooling length is often shorter than in conventional PVC extrusion processes due to different flow behaviors



Brushed surface



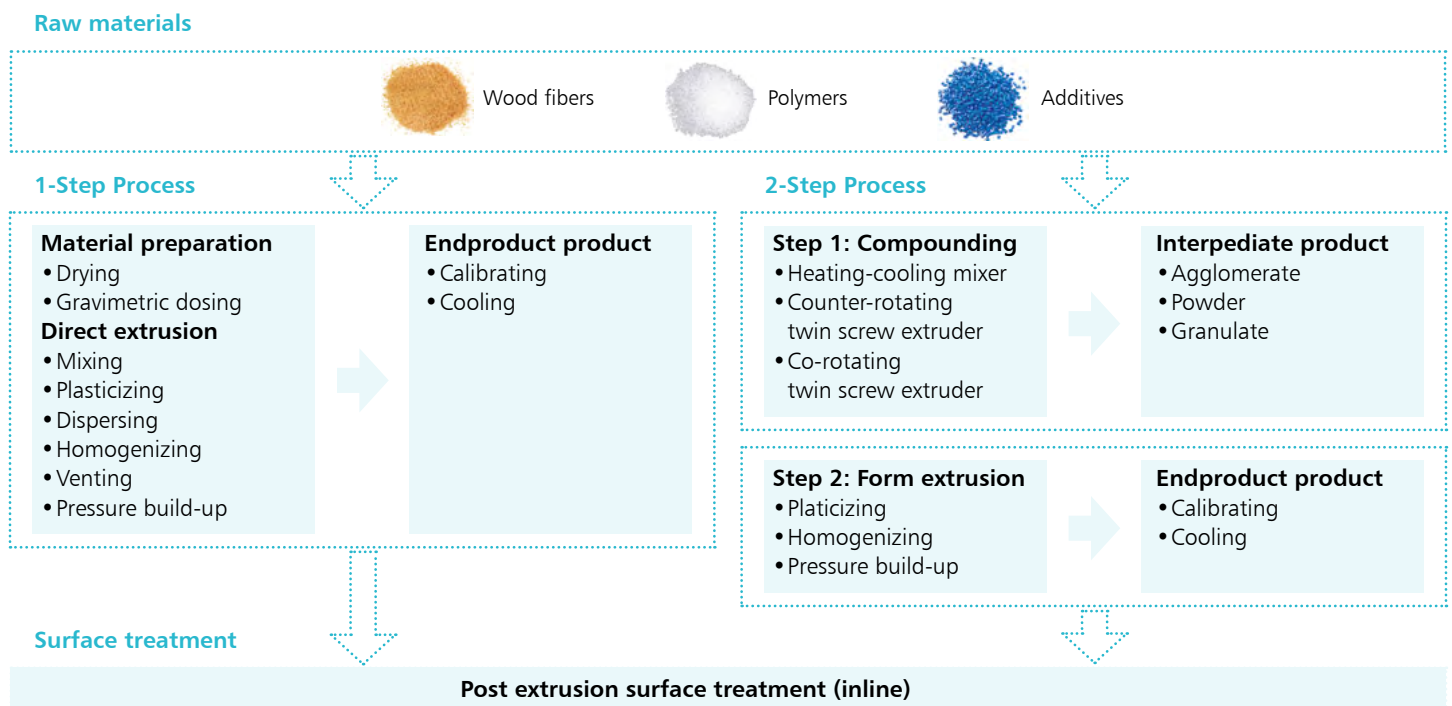
Sanded surface



Embossed surface

## Complete lines for processing composites – Processing WPC/NFC and trends

Not only the right formulation, but also the way it is processed and homogenized, are crucial for producing composites. battenfeld-cincinnati offers system solutions for both the process itself and process support. In the industry, two basic extrusion processes are distinguished. Due to its higher process stability as well as higher output capacities and easier operation, the 2-step process has largely superseded the 1-step process.



### Processing trends

In recent years, a strong international trend towards co-extrusion has developed. Co-extrusion technology reduces material costs, which often constitute 70% of production costs. In particular, the reduction of high-priced formulation components (e.g. colorants, UV stabilizers) is a major concern, with a high-quality outer layer (co-ex layer) to ensure optimal product attributes and looks.

While “cap stock” (a pure polymer layer) is the most popular variant in the USA, WPC formulations with “wood aesthetics” are being used in the rest of the world.



#### Outer layer:

- Virgin material
- Lower fiber ratio
- High content of UV-stabilizers
- High pigment ratio
- Pure polymer layer (cap stock)

#### Inner layer or core layer:

- Higher ratio of recycled material
- Lesser/no content of pigments
- Lesser/no UV-stabilizer, etc.

# Complete lines for processing composites – fiberEX Extruder Series

## 1a Horizontal dosing unit

- Material hopper with emptying device
- AC drive with fixed frequency converter

### Advantages:

- Precise filling of the screws for WPC, dryblend, pellets, granulate and regrind
- Highest process safety

## 1b Vertical crammer feeder

- Optimized dosing and feeding solution
- Hopper with stirring wings

### Advantages:

- Precise screw filling for dryblend, pellets, granulate and regrind
- Applicable for low bulk densities and/or poor flow abilities
- For broad particle size distribution

## 2 Feeding zone

- Large filling opening for addition of start/stop material
- Thermally separated feeding port

### Advantages:

- No material bridging
- Optimized material feeding
- Possibility to add additional dosing units

## 3 Gearbox

- 4-shaft gearbox concept (parallel) or
- Compact motor-gearbox solution (conical)
- Water-cooled gearbox

### Advantages:

- Maintenance-free
- Reliable, simple, safe

## 4 Control

- Touch screen operation
- Industry 4.0-compatible
- Highly efficient temperature control with auto tuning
- Visualization of automation components on the terminal
- Supporting systems for preventive maintenance (optional)

### Advantages:

- Future-proof with Windows® 10 embedded system
- Modular automation concept (gravimetrics / wall thickness regulation)
- Data transmission to SCADA systems via OPC / OPC UA interface (optional)

## 5 Drive

- Compact AC motor
- Energy data recording (optional)

### Advantages:

- Maintenance-free
- Robust and proven
- Energy-efficient

## 6 Barrel

- Full insulated barrel
- apc® (Air Power Cooling) system with tweaked air ventilation

### Advantages:

- Highest process stability
- Reduced energy loss

## 7 Vacuum system

- Stainless steel filter and filter box
- Double filter system with by-pass switch or
- Triple filter execution with material-steam separator and by-pass

### Advantages:

- Optimized filters for high moisture contents
- Bypass system for filter cleaning ex production interruption
- Simple drawer system and quick coupling system for easy handling

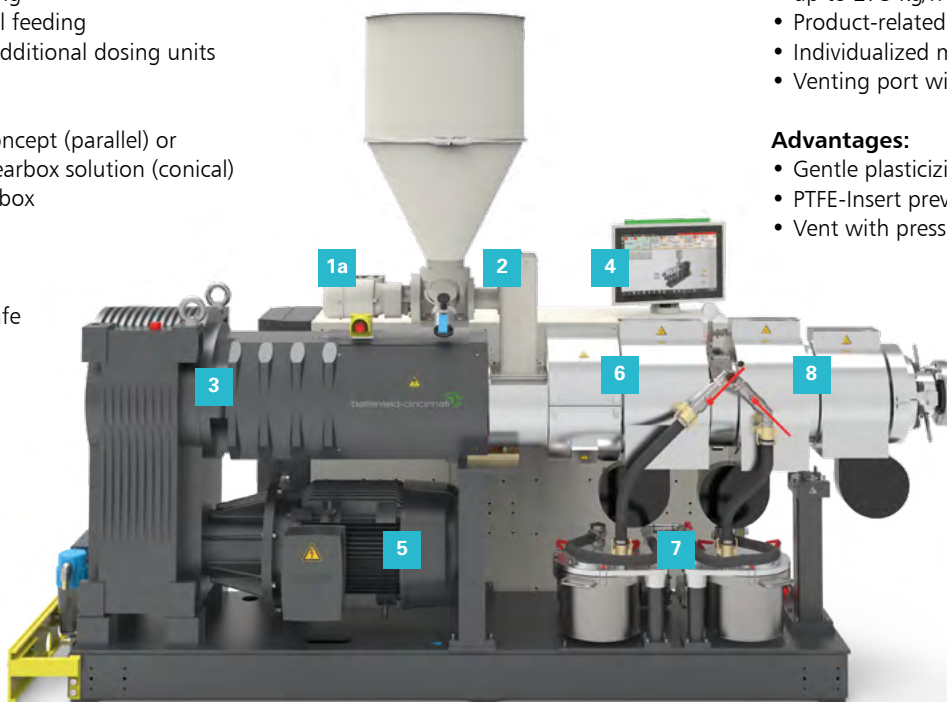
## 8 Processing unit

- Parallel execution (34 L/D) for outputs up to 1000 kg/h
- Conical execution for outputs up to 275 kg/h
- Product-related screw design
- Individualized metallurgy
- Venting port with PTFE-inserts

### Advantages:

- Gentle plasticizing and uniform melt quality
- PTFE-Insert prevent material sticking
- Vent with pressure gauge

fiberEX 72  
back view



	2-step-process	direct-extrusion		
Conical	kg/h	kg/h	kW	rpm
fiberEX 42	35 - 100	30 - 80	19.3	47
fiberEX 54	50 - 155	45 - 125	36	45
fiberEX 65	90 - 230	70 - 200	54	42
fiberEX 72	90 - 275	80 - 220	40	24

	2-step-process	direct-extrusion		
Parallel	kg/h	kg/h	kW	rpm
fiberEX 93	160 - 400	130 - 325	85	40
fiberEX 114	230 - 480	190 - 480	118	33
fiberEX 135	500 - 1000	400 - 800	180	27

Output can vary depending on processed material, process parameters, up-stream and down-stream equipment.

## battenfeld-cincinnati Services – Worldwide active for you

We have an extensive service network at our disposal to support our customers professionally and promptly with technical know-how and spare parts. Our locally available service technicians are regularly trained on the current state of the art and informed about new developments.

### **Wear Analysis**

- Regular wear measurement
- Wear protection consulting

### **Spare Parts**

- Tailor-made spare parts packages
- Innovative screw design

### **Extruserve**

- Completely overhauled extruders
- Screws repair for many external extruders
- Screws & barrels for other brands

### **Repairs & Upgrades**

- Control retrofits
- New drives for extruders & successions
- Repairs of screws, gears, controls & drives

### **Technical Service**

- Commissioning, maintenance, inspection
- Repair-in-the-field-Hotline
- Remote diagnosis system

### **Support & Training**

- Consulting & training
- Inspection & service contracts
- Energy-saving advice
- Forecasting required key parts
- Material analyses & pilot plant



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