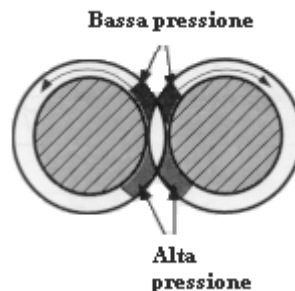


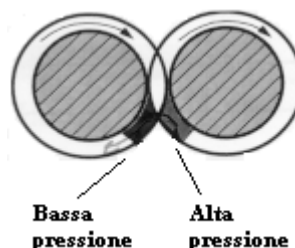
ADVANTAGES OF CO-ROTATING TWIN SCREW EXTRUDER SOLUTION IF COMPARED TO COUNTER-ROTATING ONE

The **counter-rotating** extruder has a limit on the maximum screw rpm available (60 rpm) and this means lower productivity and lower mixing capability. With this solution the material is pushed between the 2 screws creating an high pressure and so a deformation of the screws. In order to limit the abrasive action on barrel surface a velocity higher than 50 rpm is not possible.



Due to the low screw rpm of counter-rotating solution, the melting performance is not so high. A polymer in a powder form is the best solution in this case in order to maximize the melting performance. But it is expensive if compared to the cost of a plastic granule. The mixing quality, always dependent on the shear effect generated by the screw that depends on the screw rpm, can not be so efficient.

The **co-rotating** extruders can work at a very high screw rpm (up to 1800 rpm). There is no mechanical limit. The reason is that the material is not pushed between the 2 screws due to the co-rotating motion that creates an 8-shaped trajectory. For the NMC products the maximum screw rpm possible on co-rotating twin screw extruders is 150.

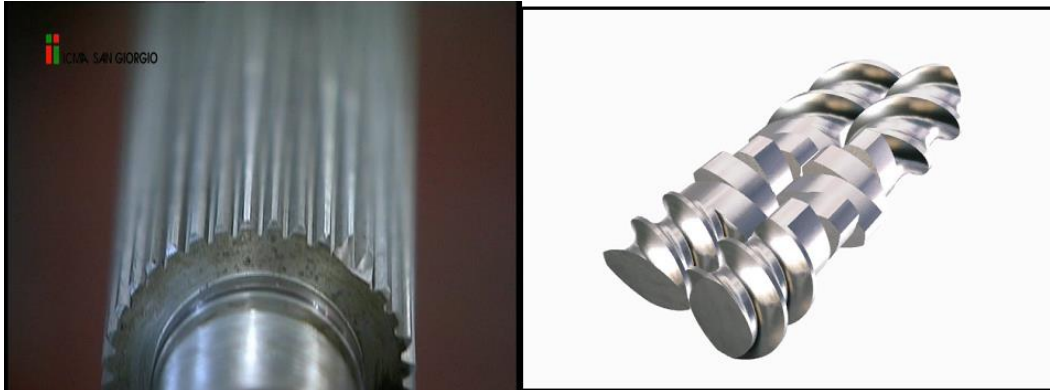


So the melting performance and the mixing quality reachable with this solution is incredibly high. At the same screw diameter, the capacity of the co-rotating solution is far superior thanks to the higher screw rpm.

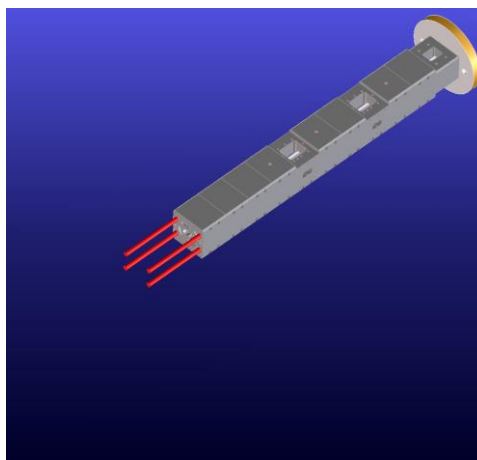
The degassing phase of the process is very important for Wood Plastic Composite product. In this phase all the moisture is extracted from the material (no more than 0.5 % will remain inside the composite) limiting the degradation problem and so the drop of the mechanical properties of the composite. The degassing performance of a co-rotating is far superior than the counter-rotating one due to a better control on the residence time and a better renewal of the melt layers during the degassing phase.

So it's possible to manage raw materials with a moisture content higher than the one acceptable for the counter-rotating.

The co-rotating is engineered with a modular design. Both the screw and the barrel are composed by different pieces that can be easily moved to change the configuration of the extruder. This is not possible on a counter-rotating. This gives a high flexibility to co-rotating solution.



Screw shaft and a portion of screw configuration



Barrel configuration

The possibility to compose a screw using 3 main types of elements (conveying, kneading, mixing), gives the advantage to have a full control on the energy transferred to the material.



Conveying element



Kneading element



Mixing element

The amount of energy transferred is depending on the selected screw elements in the specific location.

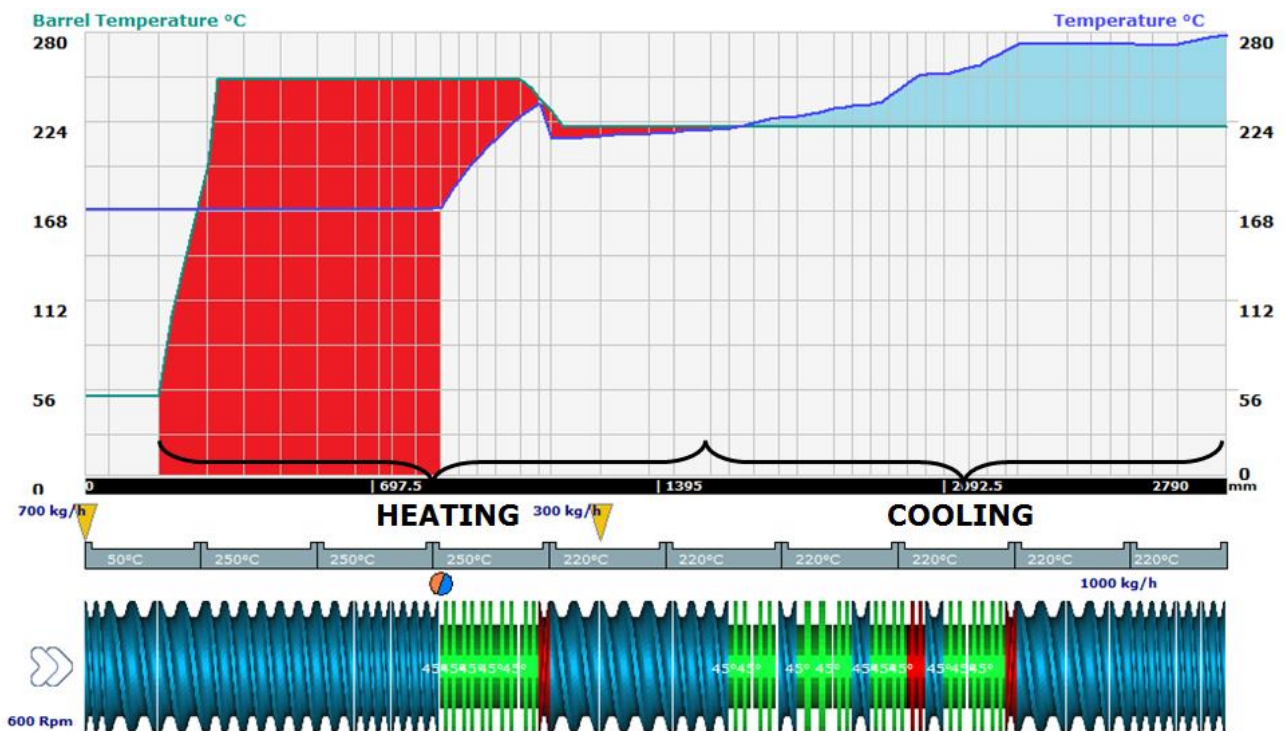
If no kneading or mixing elements are present in a specific zone of the screw, no energy is transferred to the material.

In a counter-rotating extruder energy is transferred in every location of the screw because the material is pushed and sheared when it's passing between the 2 screws.

Changing the screw element in a specific location of the extruder means also to change the residence time of the material in that location.

So a perfect control on the energy transfer and on the residence time means a perfect control on the product temperature increase.

This means a perfect control on the quality of the extruded product.

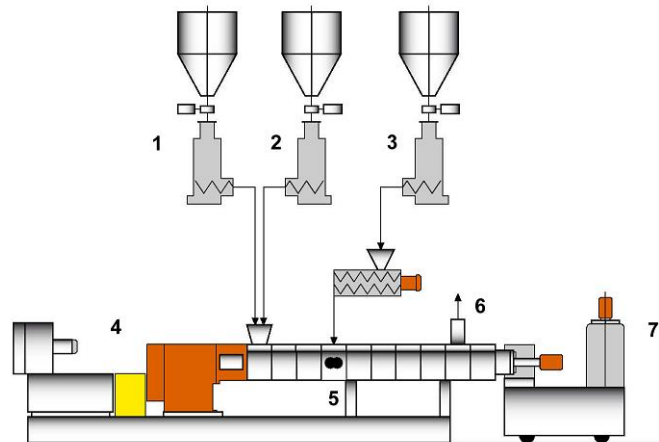


Temperature evolution of the material inside the extruder

Even from a maintenance point of view the modular design of the extruder can give an added value. When you need to change the screw or the barrel for wear/corrosion problem you don't need to change all the screw/barrel but only the critical portion of them.

With a co-rotating extruder the feeding of the raw materials that compose the formulation can be divided along the axial coordinate of the barrel (not in the case of NMC). An example is below:

- Dosing unit 1 – polymer granules
- Dosing unit 2 – premixed additives
- Dosing unit 3 – fillers/fibers



The abrasive materials like fillers or fibers are fed in a position when the polymer is completely melted, so this will reduce a lot the abrasive action on the screw and on the barrel, reducing also the torque needed and so the power consumption.

This split fed is not possible on a counter-rotating extruder.

A summary of the **advantages** related to the co-rotating extruder:

- Lower extruder size for the same capacity
- High melting efficiency
- Better mixing (dispersive / distributive)
- High venting efficiency
- Modular design for screw and barrel
- Easy re-configuration of the system
- Reduced maintenance time and cost
- Modular design = fine tuning of the screw configuration → better control on energy transfer and residence time
- better quality of the final product
- easier product change
- shorter time and lower power consumption to heat up the extruder (smaller size)
- lower motor power consumption for some specific process