

Level Measurement in Polypropylene Reactors

The following describes level measurements in polypropylene reactors using a process licensed by BASF.

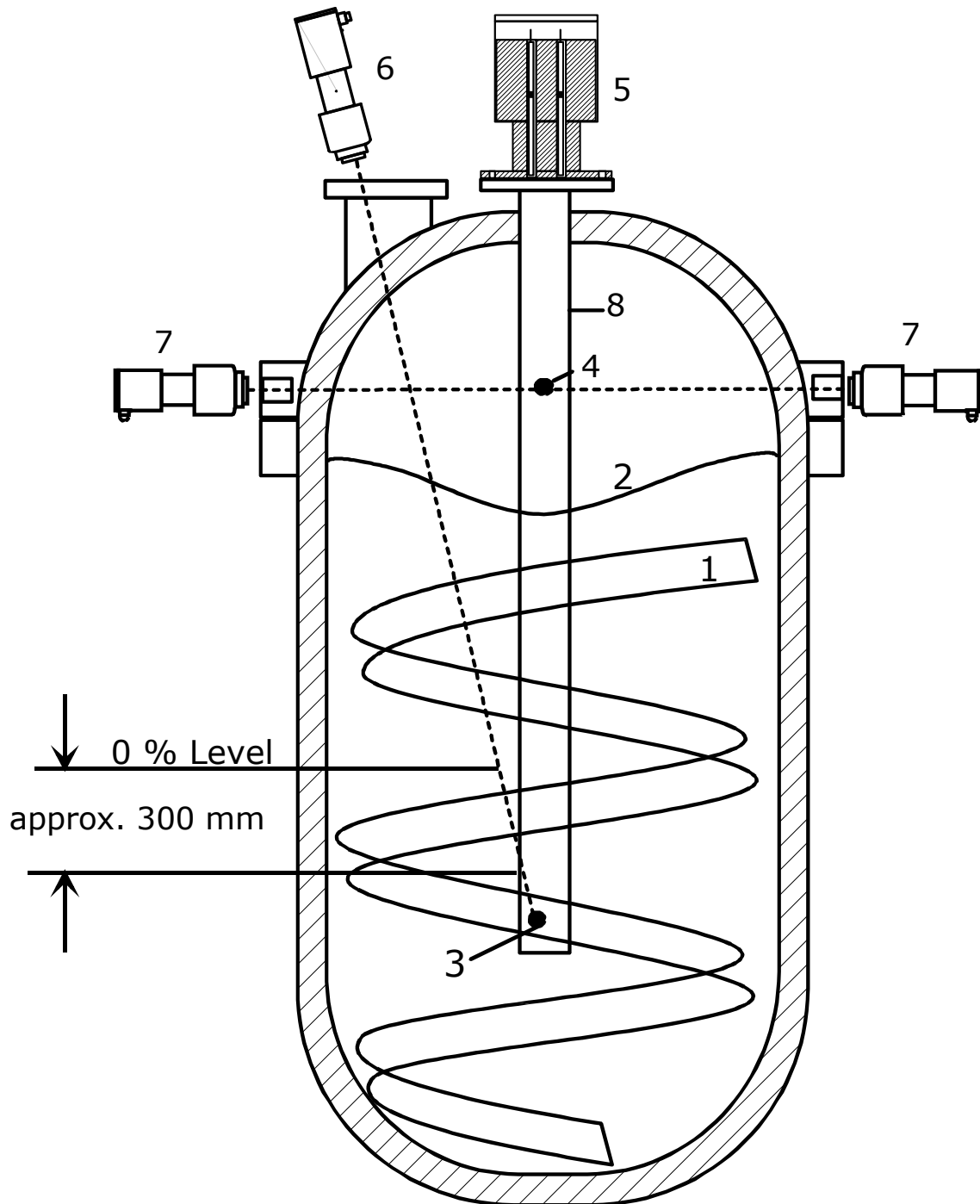
Description of the process:

Initially, the vessel is filled with polypropylene powder and a catalyst, which is mixed with the powder. The vessel has a large helix-stirrer to mix the product and to heat the mixture by friction. This method ensures that most of the energy consumed by the stirrer motor is converted into heat energy and transferred to the powder.

Liquid propylene gas is introduced into the vessel both at the top and at the bottom. Additionally, liquid gas is introduced into the top of the vessel for partial cooling of the process.

The combination of temperature and the presence of the catalyst cause the gas to be polymerised into polypropylene powder. The powder is discharged via a cyclic "open" and "closed" valve.

When this process is used for producing polypropylene it is called the "HOMO" process, using the "HOMO Reactor". The same process is also used for mixed polymers (polypropylene + polyethylene), in which case it is called the "COPO" process.

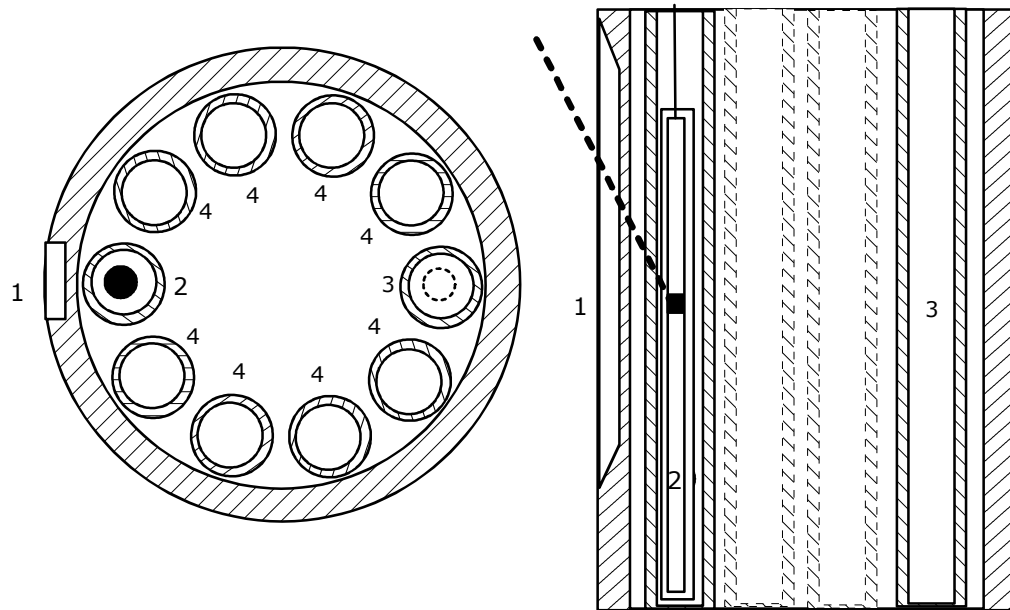


Legend:

1	Helix - Stirrer	5	Shielding for both sources
2	Powder level	6	Detector for level measurement
3	Source for level measurement	7	Detector for level switch
4	Source for level switch	8	Dip pipe

Level Measurement:

As a result of the stirrer rotation the surface of the powder is not flat but is shaped like a trough. The operating level is in the area of the flange. This flange is very thick and large and therefore cannot be irradiated. This means that the only satisfactory level measurement can be made using absorption together with a rod source or rod detector.



Legend:

1	Groove	3	Source for level switch
2	Source for level measurement	4	Pipes for thermo sensors

Arrangement:

In the centre of the vessel is a 5" or 6" dip pipe. In this dip pipe there are several (10-12) small guide pipes. Most of the guide pipes are equipped with temperature sensors or an additional level measurement (The temperature in the powder bed is higher than in the gas area above the powder bed).

A source is installed in one of the guide pipes for the continuous level measurement. The detector is located at the top of the vessel on a flange, which has a thin window. The dip pipe in the area of the point source is grooved. That means that for a length of approximately 400...1000 mm there is a slot in the wall of the tube. This is important because it compensates for the unfavourable angle of the radiation beam towards to the detector at the top.

One other source is used for a level switch near the upper end of the flange.

Continuous level measurement:

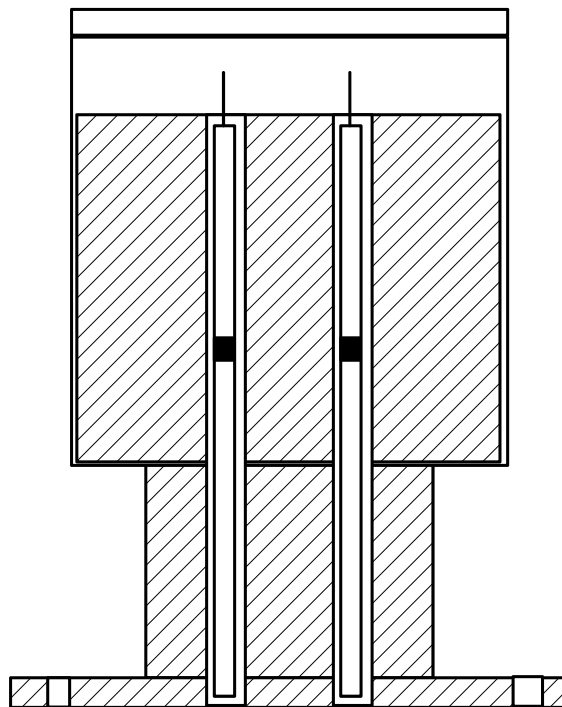
The measuring range cannot start at the intersection of the beam with the dip pipe. This is because the low bulk density of the powder at the beginning combined with a rising level causes the pulse rate at the detector to be modified by scattered radiation. After approximately 300-400 mm the pulse rate turns into a continuous falling curve as the level increases. The real measuring range is limited to approximately 500-700 mm depending on the bulk density of the product. The bulk density varies depending on the kind of product (HOMO or COPO).

Above of the powder bed there is gas at high pressure. The gas density is approximately 60 kg/m^3 and fluctuation of the gas density varies the absorption and therefore, the displayed level signal.

One customer uses the source of the level switch for measuring gas density to compensate (in the PLC) for the fluctuation due to gas density changes.

Shielding:

A typical shielding for this purpose is shown in the sketch below.



One customer has installed only the source for the continuous level measurement in the central dip pipe and installed the source for the level switch in a separate dip pipe outside of the center.

Calibration

To facilitate the simplest calibration, BERTHOLD supplies a calibration program with the systems. According to previous experiences with this program a calibration with

- a) empty vessel
- b) a powder level > 70%

is possible. The powder features as well as the gas density under operating conditions are included.

Gas Density Variations

Gas density variations may lead to measurement errors. Please contact BERTHOLD if you need continuous gas density compensation. We will be pleased to advise you.