Understanding dynamic range and the versatile future of radar level sensors

From grain silos to oil refineries to chemical facilities, radar level sensors are trusted to keep processes humming along at maximum efficiency. As products and processes have grown more complex, radar technology has adapted to keep pace with market demands. One of the ways these instruments have advanced is by increasing dynamic range. This paper will explain dynamic range, its importance in solid and liquid applications, and how large dynamic range benefits the end user.

Dynamic range, explained

Measured in decibels (dB), dynamic range is an indicator of sensitivity; it refers to the range of usable signals a device can detect. The larger the dynamic range of a radar instrument, the smaller the signals it can measure in operation, and the more useful it is to multiple industries.

To gain a conceptual understanding of dynamic range, consider two common types of scales found in the home. A standard digital bathroom scale measures weights up to 330 pounds and does so in 0.2 lbs. increments. Considering 0.2 lbs. is a small value and 330 lbs. is quite heavy, it's safe to say that a bathroom scale has good range. Moving to the kitchen, we'd find that the produce scale has good range, too, as the average home produce scale measures about 11 pounds in 0.1 ounce (0.00625 lbs.) intervals. Each scale is limited to a determined range of weights it can measure, and we can compare the sizes of those ranges. (In case you're curious, the produce scale has a larger dynamic range, but the contest is close.) The same holds true for radar sensors: We can compare the range of signal sizes they detect.

The value of large dynamic range

The value of large dynamic range in a radar instrument depends on the application. Some media return stronger signals than others and process conditions (foam, for example) might require a sensor with large dynamic range. The realities of the application will dictate the significance of a sensor's dynamic range. In this way, our scale analogy holds up.

Just as with radar instruments, the value of a scale's range differs depending on application. A dieter depends on the range of the produce scale to weigh in ounces the blueberries he eats for breakfast. He also depends on the range of the bathroom scale to measure in tens (or hundreds) of pounds the effects of his healthy diet. Substituting one scale for the other is of no help to the dieter. As in the process industry, the value of a radar level sensor's dynamic range changes with each application.

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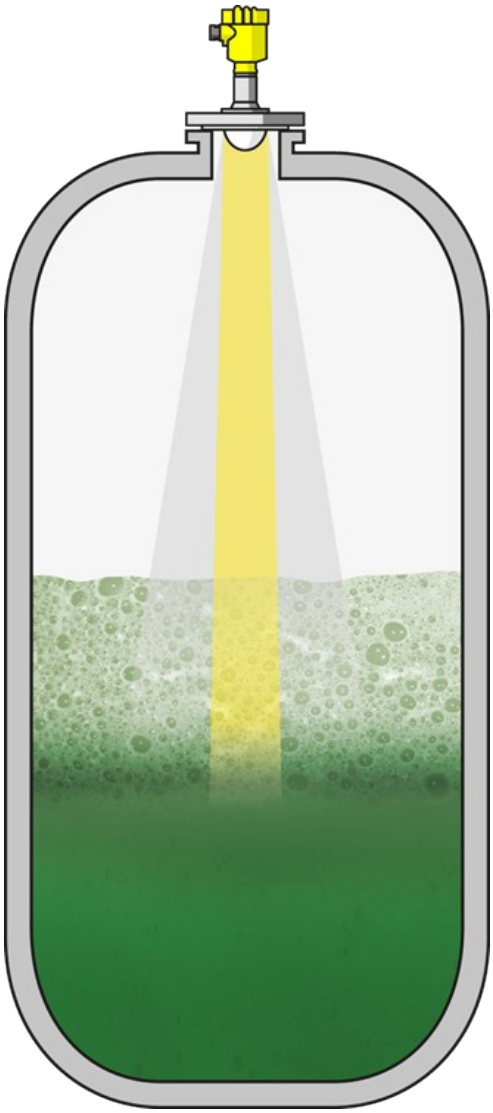
Incremental advancements make a huge difference

The most sensitive radar sensors on the market have a dynamic range of 120 dB, five times greater than the previous generation of sensors that offered a dynamic range of 112 dB. This is an enormous improvement. All things being equal, the clearest signal detected by a radar sensor with a dynamic range of 112 dB is only one-fifth as clear as it would be if the sensor had a dynamic range of 120 dB. Those are results you just cannot ignore. To understand how big that factor of five really is, we return to the scales.

Imagine a radar level device with dynamic range of 112 dB is a bathroom scale. You could park a truck on that scale and remove a hair from your head and the scale would detect the difference. That's incredibly sensitive. However, if a radar sensor with dynamic range of 120 dB were a scale, you could do the hair trick while sitting on a train, and the scale would show the difference. That level of sensitivity is revolutionary. Installing these 120 dB radar devices in a plant is the equivalent of owning a home scale that reaches the light end of the produce scale's range, the heavy end of the bathroom scale's range, and far, far beyond.

Practical benefits for end users



Radar sensors with large dynamic range can compensate for foaming in level applications.

Sensors with 120 dB dynamic range can measure virtually any product, no matter how low the dielectric constant (DK). This is quite a paradigm shift; as DK value was recently the most significant determinant of whether or not a radar sensor will work in a level application. Thanks to large dynamic range, radar level measurement is a viable solution for industries and applications where it had previously been disqualified. The chemical industry, for example, is thick with liquids, solids, and powders that don't easily reflect radar signals. These low-DK materials demand a radar instrument that performs more like a produce scale than a bathroom scale to detect their miniscule signals. The **VEGAPULS 64** from VEGA is such a radar sensor and is installed successfully in several chemical applications.

Chemical composition isn't the only reason to choose a sensor with large dynamic range to measure process liquids. Dynamic range helps a radar sensor perform in difficult conditions. For instance, foaming runs rampant in chemical vessels that use an agitator to mix or dissolve liquid product. Operators hesitate to use radar instruments in these applications because foam dampens radar signals. However, radar devices equipped with large dynamic range compensate for foam by detecting the small signals that make it back through the foam.

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Conclusion

Dynamic range of a radar device refers to its ability to detect signals of differing amplitudes. The larger a sensor’s dynamic range, the wider its potential for use in industrial processes. Radar sensors with the biggest dynamic range can measure level in practically any application, no matter how low-decibel the return signal. This sensitivity is an enormous improvement on previous radar sensors and it makes radar a viable technology in industries that previously ruled it out, giving plant operators a new, reliable option for process measurement.

Discover more about radar level measurement

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