How do I measure the stability of emulsions or suspensions by the addition of salt?

Electrostatically stabilized dispersions are stable only when the charge on the dispersed particles or droplets is high and the ionic strength (salt concentration) is low. The theory that describes this mathematically is called the DLVO theory. One of the triumphs of DLVO theory was to "explain" the Schulze-Hardy rule which said that the stability of a dispersion decreases as the sixth! power of the charge on the counterions. The counterions are the ions in solution with the opposite sign as the charged droplets or charged particles.

Nowadays most researchers concentrate on measuring the charge on the particles or droplets by some electrophoretic or acoustophoretic technique. The measured charge is given in millivolts and is called the zeta potential. Roughly, the higher the zeta potential, the more stable the emulsion or dispersion.

As your question points out, the stability of an electrostatically stabilized dispersion can also be judged by how much salt must be added to flocculate the emulsion or suspension. This is a simple experiment. Samples of the dispersion are poured into beakers (or bottles, etc.) To each is added a different amount of salt. The samples are usually stirred gently and left to settle. The least concentration of salt that causes the dispersion to flocculate and settle is called the critical coagulation concentration or CCC. The CCC is therefore a measure of the stability of an electrostatically stabilized dispersion.

A simple procedure is to make up a concentrated salt solution, say 1 M and make dilutions. You will probably want to add enough salt to each sample so that the salt concentration after addition varies from a few to a few tens millimolar. It is best to add salt solutions as adding pure salt would lead to high local concentrations of salt during the initial mixing and this may lead to odd results. Obviously, if all the samples flocculate, then repeat the experiment with less salt and, similarly, if none of the samples flocculate, add more. With a little practice, you can get quite proficient at this measurement. It is far less costly than buying the equipment to measure zeta potential and I think it gives you just as fundamental measurement far easier.

By the way, if the dispersion is stable to high concentrations of salt then it must be sterically stabilized. Adsorbed or attached polymers stabilize sterically stabilized emulsions and suspensions. These polymers are not much affected by the addition of salt. Another point - the electrostatic stability of an emulsion or dispersion is often quite sensitive to the volume loading of dispersed phase. Be sure to take this into account when you measure the CCC by not adding too much extra solvent. I have seen some companies use divalent salts such as soluble calcium salts. Because of the higher charge per ion, much less salt needs to be added. This also has the advantage of mimicking real situations since many dispersions are mixed with water that has not been softened (that it, water that might contain multivalent ions such as calcium, magnesium, aluminum, or iron.)

