

# **Methods of Fitting Compressional and Shear Wave Velocities Versus Water Saturation Curves, and the Interpretation of Laboratory Velocity Measurements in Partially Gas-Saturated Rocks**

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Elastic wave velocities vary with fluid saturation, and understanding the influence of fluid saturation on elastic velocities is very important in the interpretation of seismic direct hydrocarbon indicators. The effect of fluids on elastic wave velocities of porous media has been studied by both theoretical and experimental techniques. It is still an unresolved problem in rock physics that laboratory measurements of P & S wave velocities versus water saturation do not match the Biot-Gassman theory. The influence of pore fluid saturation on elastic waves is related to many factors like pore geometry, distribution of fluid phase, compressibility, mass coupling factor, chemical interaction between fluid and solid, and pressure. Fitting theoretically or empirically known velocity versus water-gas saturation curves is very important in solving interpretational problems like correcting for the dispersion needed for seismic and well logs interpretations. This will be accomplished by extending Biot's theory to include separation of acoustically connected and disconnected porosity, considering three separate fluid distribution systems: (1) Uniform system where the gas and water fill the mixed shape pores homogeneously at low water saturation, (2) Segregated system where the gas fills the pores of high aspect ratio at high water saturation, (3) Patchy segregation system where the gas shows patches of uniform or segregated at medium water saturation. And by considering different effective fluid moduli for mixed phases in mixed shape pores. The results will be compared to laboratory velocity measurements reported in the literature.