

TRIBUTE TO EDWARD J. WASP

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Edward Joseph Wasp died peacefully in San Rafael, California on August 31st, 2015. He was 92.

Ed was born in the Bronx in New York City on June 6, 1923, one of seven children of Anna Fitzgerald and Joseph Wasp. He attended Christopher Columbus High School, graduating in 1941. He received a B.S. in chemical engineering in 1945 from Cooper Union, and an M.S. in chemical engineering in 1947 from New York University. He obtained a Master's degree in mathematics from the University of Pittsburgh in 1961. A move to California to join Bechtel in 1963 forced him to stop work just short of obtaining a Ph.D. in mathematics. In 1973 he earned a Master's degree in Business Administration from Golden Gate University in San Francisco.

He joined Consolidation Coal in 1951, heading up their extensive development program on coal transportation by pipeline. This is where his subsequent life-long involvement in long-distance slurry pipelines began. The research led to the construction of the world's first long-distance slurry pipeline, the 166 km Ohio coal pipeline, which started operation in 1957. The concept that, given suitable particle size and slurry properties, a fully-welded, buried pipeline could be designed to transport coal slurry for 15 or 20 years without eroding or corroding, was a bold step in technology.

After Ed joined Bechtel he assumed the lead for all slurry pipeline activities. In 1965 construction began on the world's first iron ore slurry pipeline, the 85 km Savage River magnetite pipeline in Tasmania, Australia, which began operation in 1967. Under Ed's leadership, numerous world-first slurry pipelines then followed: The 437 km Black Mesa coal pipeline in USA in 1970, the Waipipi iron sand ship loading system in New Zealand and the 27 km Calaveras limestone pipeline in California in 1971, the 110 km West Irian and the 27 km Bougainville copper concentrate pipelines in Papua New Guinea in 1972, the 45 km Pena Colorada iron concentrate pipeline in Mexico and the 18 km Pinto Valley copper concentrate pipeline in Arizona in 1974 and so on, up to the 405 km Samarco iron ore pipeline in Brazil in 1977.

In 1974 Ed took a lead role in the Energy Transport Systems Incorporated (ETSI) consortium which proposed a large diameter, 2500 km coal pipeline to transport low sulphur coal from Wyoming to power stations in the SE of the USA, which was scheduled to commence operation in 1979. Notwithstanding ETSI's success in obtaining all the Right of Way, including litigated railroad crossing permits, the owners cancelled the project following a railroad funded lawsuit over the validity of the water permit. ETSI successfully sued the railroad companies for compensation in an anti-trust law suit. But ETSI's and Ed's dream of multiple long distance coal pipelines within the USA had been thwarted. Notwithstanding these obstructions, long-distance slurry pipelines have developed into a new industry, offering an economical and environmentally superior transport alternative. Over 8000 km of slurry pipelines are now in operation world-wide.

Slurry pipeline design was initially based on pipe loop testing of large bulk samples, which could be prohibitively expensive to produce. Ed developed procedures, including rheology testing in rotational viscometers, to confidently predict slurry pipeline hydraulics based on laboratory scale sample testing. These procedures were based on expressions for C/C_A , the ratio of concentration at the top of the pipe to that in the middle of the pipe. His C/C_A criterion allowed the slurry to be split into a homogeneously suspended, fine particle, vehicle slurry, and larger, non-uniformly suspended particles travelling heterogeneously. He, and co-workers, presented C/C_A data for a range of solids including coal, in pipe sizes up to 450 mm and even compared C/C_A at the start of the Ohio pipeline and 160 km downstream. The pipe diameter and length scale of this data greatly exceeded that of most other workers at this time. Ed was also among the first to recognise the role of laminar-turbulent transition in deposition. All this work culminated in the book "Solid-Liquid Flow – Slurry Pipeline Transportation", by Wasp, Kenny and Gandhi in 1977. Ed was awarded the prestigious Elmer A. Sperry award in 1981 for his work in developing slurry pipelines. In 1982, *Pipeline* called Wasp the "patron saint of slurry pipelines". He was a dear friend and mentor to many Pipeliners. Ed led the pipeline industry into a new field and made a tremendous impact, not only technically and economically, but as a leader and a person respected by all who knew him.

Ed is survived by his wife of 33 years, Helena Troy, sister Margaret Jackson, and children; Jean, Suzanne, Edmund, Mayra, and Patricia; and grandchildren and great grandchildren.