Pressure fluctuation caused by moderate acceleration[1]
YOSHIYUKI TAGAWA, CHIHIRO KURIHARA, AKIHITO KIYAMA, Tokyo Univ
of Agri Tech — Pressure fluctuation caused by acceleration of a liquid column is
observed in various important technologies, e.g. water-hammer in a pipeline. The
magnitude of fluctuation can be estimated by two different approaches: When the
duration time of acceleration is much shorter than the propagation time for a pres-
sure wave to travel the length of the liquid column, e.g. sudden valve closure for a
long pipe, Joukowsky equation is applied. In contrast, if the acceleration duration
is much longer, the liquid is modeled as a rigid column, ignoring compressibility of
the fluid. However, many of practical cases exist between these two extremes. In
this study we propose a model describing pressure fluctuation when the duration
of acceleration is in the same order of the propagation time for a pressure wave,
i.e. under moderate acceleration. The novel model considers both temporal and
spatial evolutions of pressure propagation as well as gradual pressure rise during the
acceleration. We conduct experiments in which we impose acceleration to a liquid
with varying the length of the liquid column, acceleration duration, and properties
of liquids. The ratio between the acceleration duration and the propagation time is
in the range of 0.02 - 2. The model agrees well with measurement results.

Yoshiyuki Tagawa
Tokyo Univ of Agri
Tech

Date submitted: 01 Aug 2017   Electronic form version 1.4