



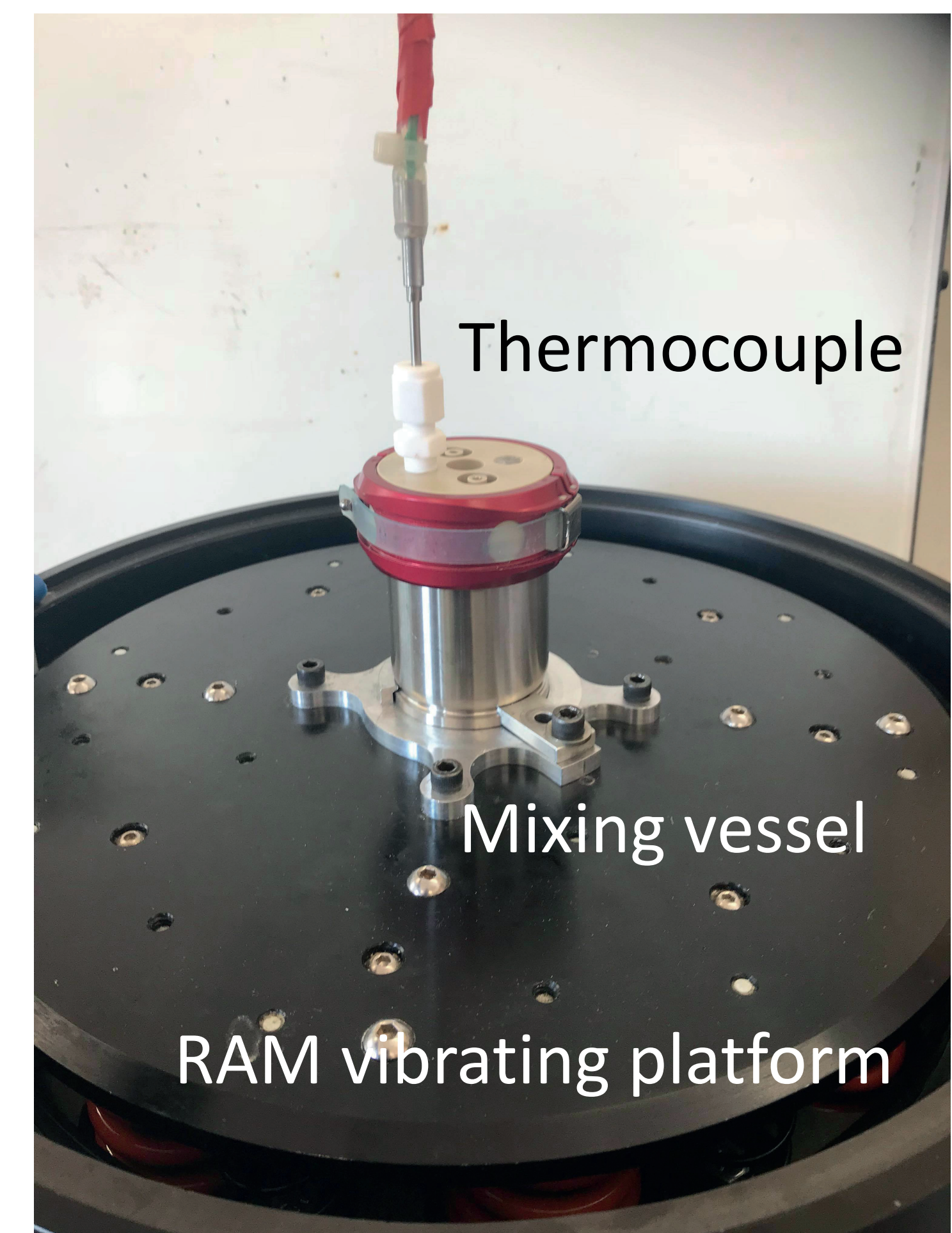
'MIXED IN CASE' EXPLOSIVES: Effects of Process Variables on Resonant Acoustic Mixing (RAM)

Introduction: To manufacture Polymer Bonded Explosives (PBXs), high explosive crystals need to be dispersed (mixed) throughout a liquid prepolymer. Resonant Acoustic Mixing (RAM) is a novel mixing technique which uses a vibrating platform, instead of mixing blades for mixing. Mixing without blades means 'mixed in case' is possible.

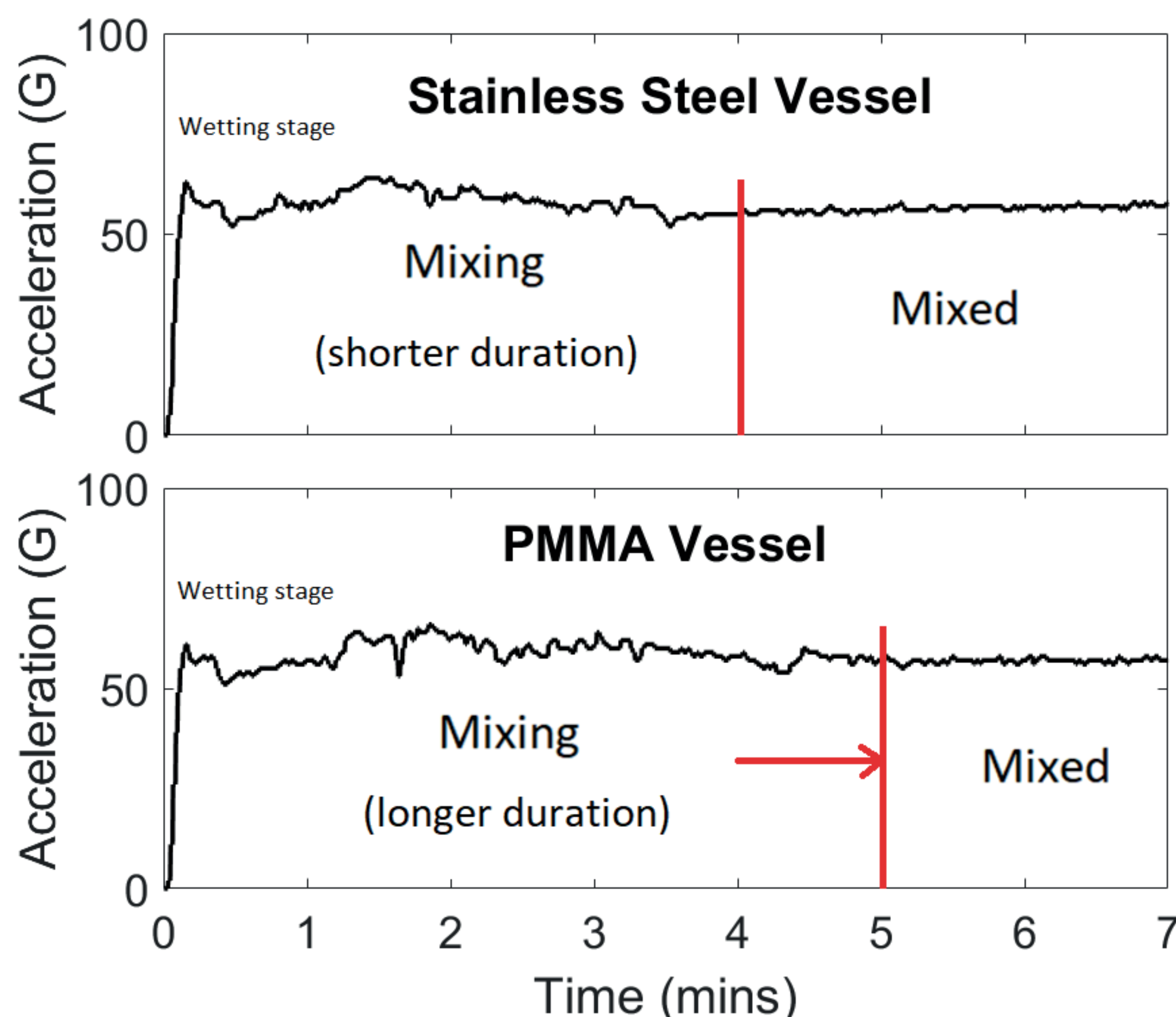
The advantages of 'mixed in case' are:

1. New high viscosity PBX formulations can be manufactured with improved safety and performance
2. Reduced waste
3. Reduced manufacturing time and costs

Theory: The viscous prepolymer must interact with the mixing vessel walls in a no-slip condition for efficient mixing.¹ It is likely that the strength of the interaction is dependant on the surface free energy of the mixing vessel. The prepolymer will likely adhere better to higher surface free energy materials.



Surface ²	SFE (mJ m ⁻²)
Plastics	20-30
Metal Oxides	200-500



Results: A comparison between stainless steel (metal oxide surface) and PMMA (plastic surface) vessels found that the time at which mixing completed (the point at which the achieved acceleration of the mixer became constant³) was 20% less with stainless steel than it was with PMMA.

Future work: This comparison will be expanded to include titanium, aluminium, PEEK, ABS, PTFE and will compare mixing time to the wettability of each surface with the PBX prepolymers of interest.

The mechanical properties, performance and safety of high viscosity PBXs (plasticiser free and micronised explosive fillers), manufactured by 'mixed in case' RAM will be investigated.

¹Resodyn Acoustic Mixers, Inc., *RAM Technical White Paper*, ResoDyn Corp, Butte, MT, USA., 2009

²J.E. Castle, *The Composition of Metal Surfaces After Atmospheric Exposure*, J. Adhes., 84, 2008, pp. 368-388

³A. Vandenberg and K. Wille, *Evaluation of resonance acoustic mixing technology using ultra high performance concrete*, Constr. Build. Mater., 164, pp. 716-730, 2018

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