THE HOT ZONE

Spring 2019

THE HOT ZONE is a semi-annual newsletter from Blowout Engineers. Blowout Engineers is the well control division of Sierra Hamilton and provides the full scope of well control engineering, capping and well kill services to clients worldwide.

This edition contains information on the following:

- Gas Dispersion
- Well Control Equipment

Errata Sheet

The fall 2018 Hot Zone contained a typo in the equation for pressure at depth. The correct equation is as follows:

Driller's Method Circulation:

$$P_{DOI} = \frac{B}{2} + \left[\left(\frac{B}{2}\right)^2 + C\right]^{\frac{1}{2}}$$

$$B = BHP - 0.052 \times MW_O \times (TVD_{KZ} - TVD_{DOI})$$

$$BHP = SIDPP + (0.052 \times TVD_{KZ} \times MW_O)$$

$$C = \frac{0.052 \times MW_O \times BHP \times Vol_K}{ACF}$$

Where

P_{DOI} = Pressure at Depth of Interest (DOI), psi
BHP = Bottom-hole pressure, psi
MW_O = Original Fluid Weight, ppg
TVD_{KZ} = True Vertical Depth of the Kick Zone, ft
TVD_{DOI} = True Vertical Depth of the DOI, ft
SIDPP =Shut In Drillpipe Pressure, psi
Vol_K = Initial Pit Gain or Kick Volume, bbl
ACF = Annular Capacity Factor, bbl/ft

What's New

Some of our recent jobs and/or projects include the following:

- Blowout in South TX.
- Relief well and dynamic kill analysis for two wells in Australia
- Well control job in Austin Chalk
- Snubbing jobs on Texas Gulf Coast
- UGBO in the Eagleford
- MGS sizing for GOM
- Rig audit in South TX.
- Well control job in East TX.
- New First Responder in San Antonio: Stan Terwilliger 346.342.3202

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South Louisiana blowout in the 1980's
photo courtesy of D. Thompson

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Gas Dispersion

Recent industrial fires in the Houston area have provided the opportunity to observe the atmospheric dispersion of the resulting smoke plume. Dispersion of gas during a blowout generally follows the same pattern as smoke from petrochemical fires. Calculation of the gas dispersion from a blowout has gained increasing interest among regulators and the public. This is especially true when there are residents and businesses near an out of control well.

Gas dispersion calculations require input of the following data:

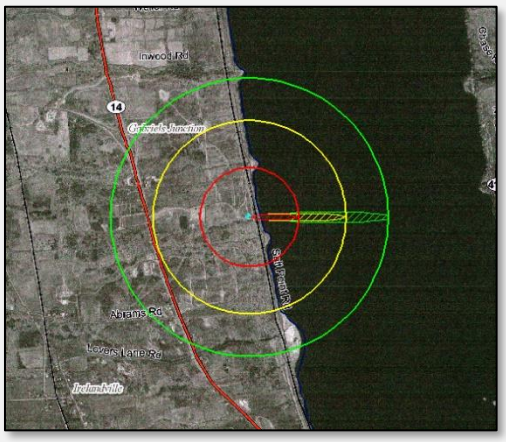
- Gas characteristics (composition, temperature etc.)
- Gas emission rate (usually in mass rate units)
- Atmospheric conditions (there are six Pasquill stability classes traditionally used)
- Surrounding terrain and infrastructure
- Source and concentration calculation height

Milton Beychok wrote the book "Fundamentals of Stack Gas Dispersion" in 1979. This work has been widely referenced and accepted by governments and universities for its presentation of gas dispersion theory.

There are numerous programs available on the internet that can provide basic gas dispersion calculations. The underlying mathematics for some of the programs are described as a Gaussian Distribution. Lagrangian model or Computational Fluid Dynamics (CFD) programs can also calculate gas dispersion.

"Screening" type programs are often used in pre-event contingency planning. The EPA "Screen" program originally was written in DOS format (that's how old it is). Several of these programs are available on the internet (some for free) and they are relatively easy to use. The output can be graphed, and the dispersion data can be overlaid on maps or aerial photos. CFD programs are more difficult and usually require the user to have significant experience with the software.

Some items to remember when performing gas dispersion calculations or analyzing results are as follows:



- Blowouts are "point source" emissions only when the well is flowing vertically (usually through a single exit point).
- Verification of the calculations is rarely done. Gas monitoring at the heights and distances the calculations determine is usually not practicable.
- The actual release rate (usually in mass units) is the biggest unknown for blowout gas dispersion calculations.
- The dispersion profile calculations are not a substitute for actual gas monitoring activities.
- Liquids associated with the flow may not follow the gas dispersion profile as they are not buoyant like hydrocarbon gasses.
- Particulate matter (smoke particles) from a blowout that is on fire will follow a general dispersion profile similar to gas emissions on a non-fire blowout.
- Gas dispersion calculations should be updated frequently due to changing weather conditions and/or blowout flow rate.
- Gas dispersion calculations for blowouts will usually be considered as a part of the permanent record of the event. Therefore, the effort put into generating the data should not be taken lightly.

Tools of the Trade

There are several equipment items from well control service providers that may be required for blowout intervention projects. The need for these different tools is situation dependent.

Firefighting Pumps

Firefighting pumps provided by well control service providers generally come in 2500, 4000 and 6000 gpm capacity. The monitors and nozzles usually used are 1000 gpm but 2000 gpm are also available. These pumps are used for heat management, fire suppression and putting out the fire once the well is flowing vertically. The use of firefighting equipment on blowouts depends on the situation. Many blowouts have been capped and/or killed without spraying water. Some regulatory agencies are now concerned with firefighting water runoff and have required the volume of water used to be predicted and documented. Limiting and capturing the water runoff can be a major part of the blowout effort.

Athey Wagons

An Athey Wagon consist of a track-mounted boom and winch system that can be used to clear debris or to maneuver equipment for capping or killing operations. Athey wagons are positioned and operated using a bulldozer. The boom elevation is controlled with a winch on the dozer or separate winch and hydraulic power pack. Examples of Athey wagon use are:

- Clear debris from around the well (hook or rake extensions)
- Positioning a diverting system when the well is blowing (Venturi tube)
- Stinging operations
- Cutter deployment (abrasive jet cutter, diamond wire saw)
- Wellhead deployment (emergency wellhead installation) and capping stack deployment

Hydraulic Athey wagons are heavy duty versions of a conventional wagon. These wagons have fine control for the boom operation and are mainly used for capping.

Stingers

A stinger is a hollow, tapered cone used to stab into tubing, drillpipe, or remains of a wellhead to kill a blowing well. The stinger provides a means to pump a junk shot and kill mud. Stingers can be mounted onto Athey wagons or the buckets of backhoes. Stinging operations cannot be done on wells with a high flowrate that may eject the stinger.

Cutters

Cutters are an integral part of blowout control operations. They are used to prepare the wellhead and/or debris removal.

- Jet cutters are used to sever drillpipe, casing, BOP and wellheads. The jet nozzles are usually positioned using an Athey wagon. Sand and water are pumped through the jet nozzle(s) and cut the wellhead, BOP pipe etc. The cutter is remotely operated and can be mounted on the Athey wagon or by other deployment methods. This cutter is especially suited for wells that are on fire.
- A diamond wire cutter (or saw) uses a diamond impregnated cable run on a powered continuous loop to cut through material via abrasion. Diamond wires offer a great way to cut through dissimilar materials such as steel and cement without having to alter the cutting method between materials. The DWS is usually clamped to the object to be cut and can be used on blowing wells.
- Lathe cutters are used on pipe (casing) to prepare the well for wellhead installation or capping.
- Exothermic cutting rods are used for debris removal to cut up thick steel (rig substructure, derrick etc.)
- Shears are mounted on excavators and used for debris removal. Shears are usually faster than cutting rods.

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CONTACTS

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These personnel act as First Responders to a well control event and can be reached 24 hr/day for any type of well control emergency.

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Blowout Engineers provides operators the full complement of well control engineering and services.

- Blowout Control
- Well Control Project Management
- Relief Well Design and Execution
- Underground Blowouts
- Pressure Control
- Special Services
- Well Integrity Assessments
- Dynamic Kill Modeling and Execution
- Kick and Kill Modeling
- Emergency Response Plans
- Rig Well Control System Audits
- Expert Witness

Blowout Engineers personnel have worked in over 40 countries and have a wide range of experience in addition to blowout control operations.

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