GasGun® Propellant Stimulations

Multiple radial fractures created by a gas-generating progressively-burning propellant

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Presentation Outline

- **Basic understanding**
  - Hydraulic fracturing
  - Explosives
  - Propellants

- **The Sandia tests**

- **Propellant stimulations**
  - Progressive burning
  - Fielding
  - Applications
  - Future Developments
Pressure–Time Profiles of Three Stimulation Methods

EXPLOSIVE: ~1,000,000 psi  
~1 microsecond

PROPELLANT: ~20,000 psi  
~10 milliseconds

HYDRAULIC: ~5,000 psi  
~1 hour
Hydraulic Fracturing

1000 PSI

2000 PSI

5000 - P

1000 - P

1000 PSI

2000 PSI

SLAP-28
Hydraulic Fracturing

Diagram showing layers of Earth with 'Oil' and 'Water' layers, and a vehicle positioned above the 'Oil' layer.
Hydraulic Fracturing
Hydraulic Fracturing

Oil

Water

1200 psi

1000 psi

800 psi

SLAP-28
Hydraulic Fracturing

Diagram showing layers of oil and water with pressure levels of 1200 psi, 1000 psi, and 800 psi.
Tests at Sandia National Laboratories
Progressively Burning Propellant
Progressively Burning Propellant
Fracture Network

CIRCUMFERENTIAL FRACTURES

25 FT TOTAL FRACTURE LENGTH

22 FT TOTAL FRACTURE LENGTH

0  1 FT
Progressive Burning

Speed of burn front \( r = a p^n \)

Regressive
Progressive Burning

Speed of burn front \( r = a p^n \)

- Regressive
- Neutral
Progressive Burning

Speed of burn front \( r = a p^n \)

- Regressive
- Neutral
- Progressive
Quarry Test in Croatia
GasGun Specifications

Diameter: 3 ⅜” & 4”

Length: 1’ to 10’

Max Temperature: 280 °F

Max Pressure: 8000 psi

Fluid Tamp: Minimum 300’
Wireline with Portable Mast
Tubing-Conveyed Propellant Stimulation
Horizontal Well in Oman
Naturally Fractured Reservoirs
Close Water Contacts
Pre-Hydraulic Fracturing
Reservoir Evaluation
Nearbore damage
Injection Wells
Horizontals
Open Hole Completions
Future Developments

- High Pressure/High Temperature – technology development project with Saudi Aramco
- Modeling Software
- Slim Hole Tool
- High Speed Recorders
- Combination Perforation/Propellant Tool
- Select Fire Capabilities