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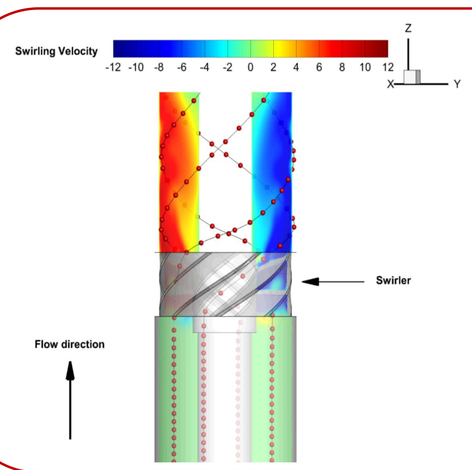
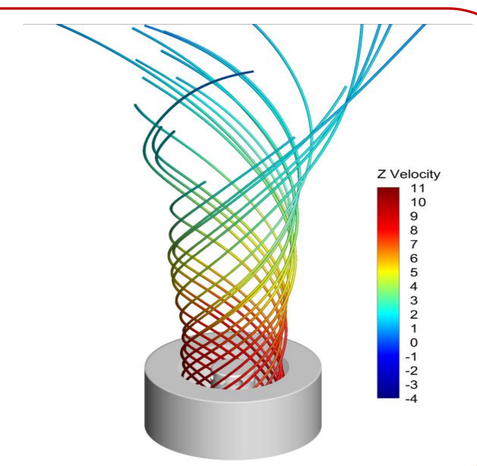


Context and objectives

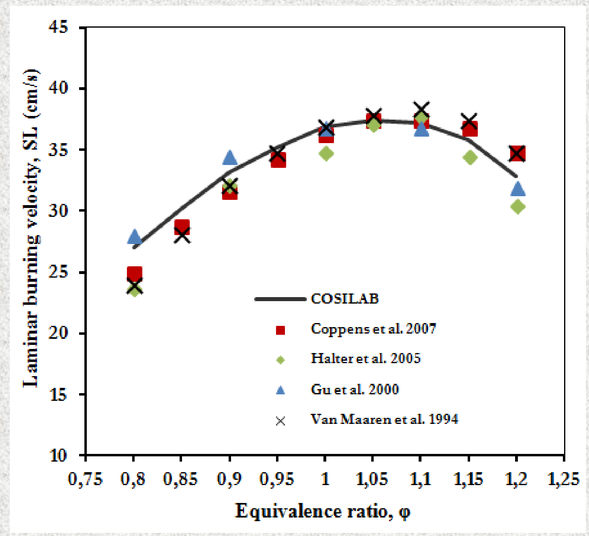
- **Study of non-premixed turbulent flames stabilized by a swirler**
  - Control of pollutant emissions / emissions standards
  - Improve performances of combustion plants
- **Investigations on flame characteristics**
  - Effects of oxygen enrichment
  - Effects of steam and CO_2 dilution
  - Effects of swirl intensity

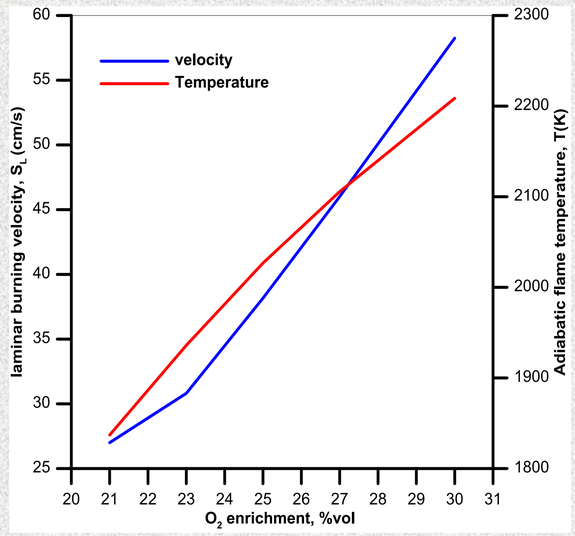


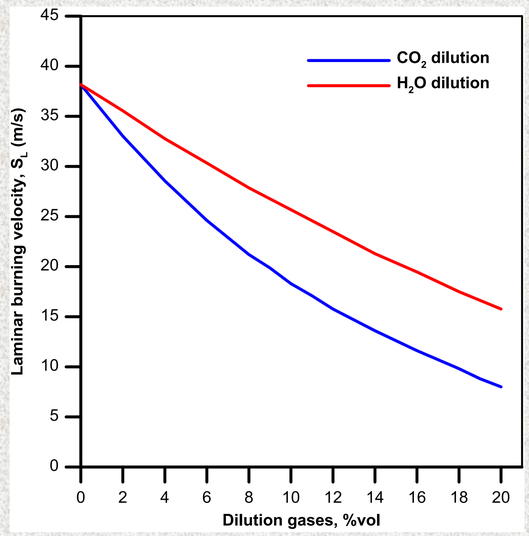
Numerical calculations

The numerical computations were conducted with **COSILAB** software

- Freely propagating methane-air flames.
- One-dimensional premixed flame.
- GRI-mech 3.0 mechanism.
- Atmospheric pressure and 300K.
- Equivalence ratio : from 0.8 to 1.2
- Oxygen enrichment : from 21% to 30%vol.
- Dilution : (0-20%vol) for both CO_2 and H_2O.



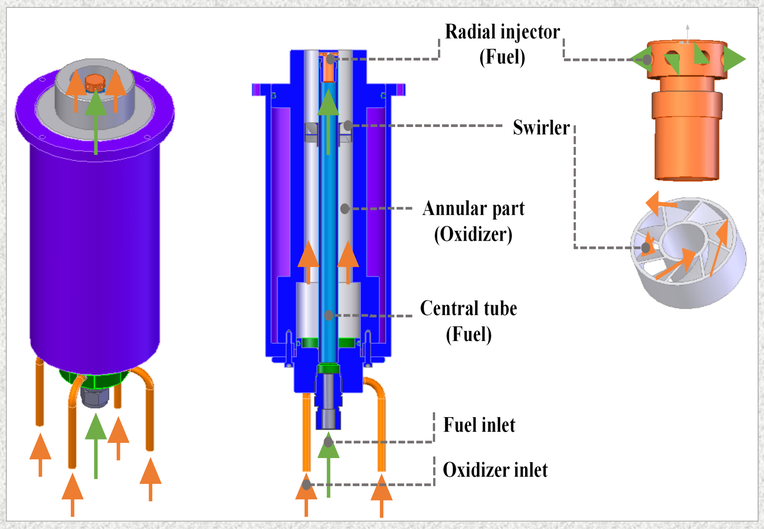




- With O_2: notable increase in flame temperature and laminar burnig velocity.
- With dilution: significant decrease in laminar burning velocity, the effect of CO_2 is greatest.

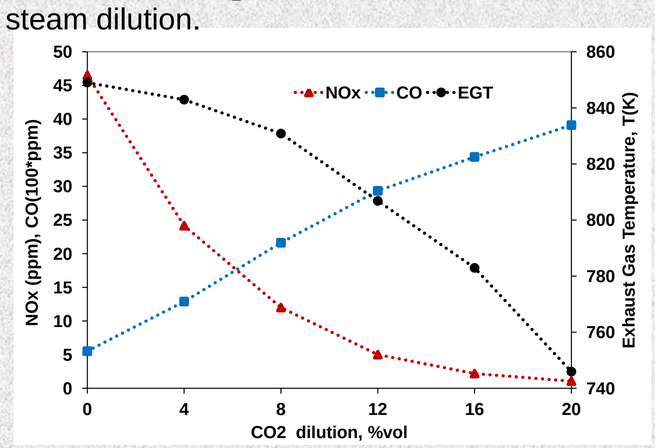
Experimental study

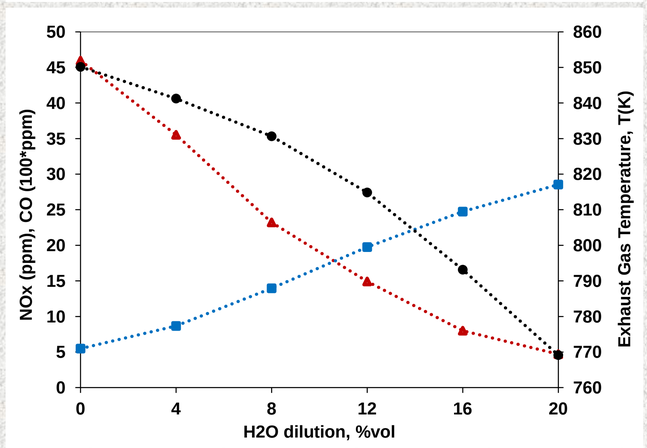
Coaxial swirl burner



NO_X and CO emissions and exhaust gas temperature are reported as a function of H_2O and CO_2 dilution. Case: Sn = 0.8, ϕ = 0.8, and 25% oxygen enriched methane/air mixture at atmospheric pressure.

→ Effect of CO_2 dilution is stronger than that of steam dilution.



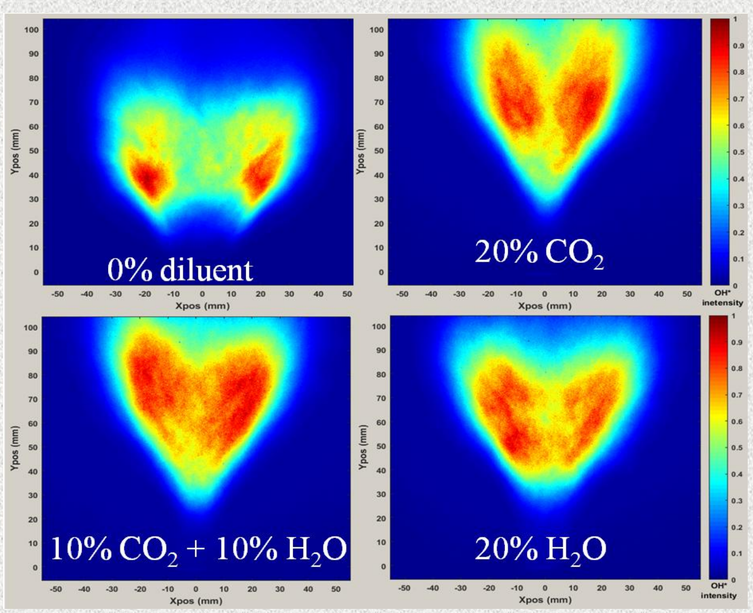


OH* chemiluminescence

OH* intensity distributions of methane/air swirling flames diluted by CO_2, H_2O and EGR, in the case of 21% O_2, for Sn=0.8 and ϕ=0.8.

→ The flame becomes taller and unsettled with dilution.

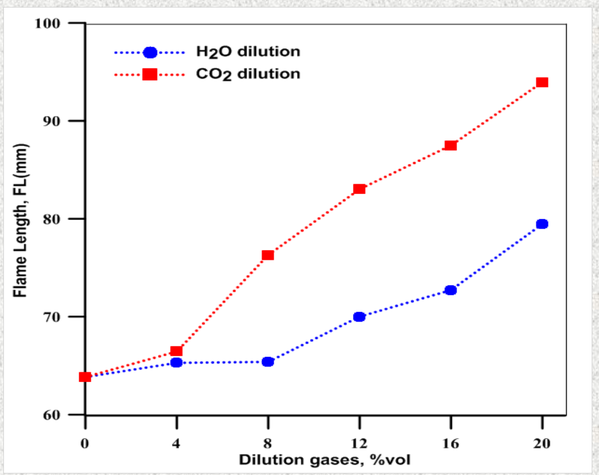
→ CO_2 has greater effect on the flame lift-off heights.



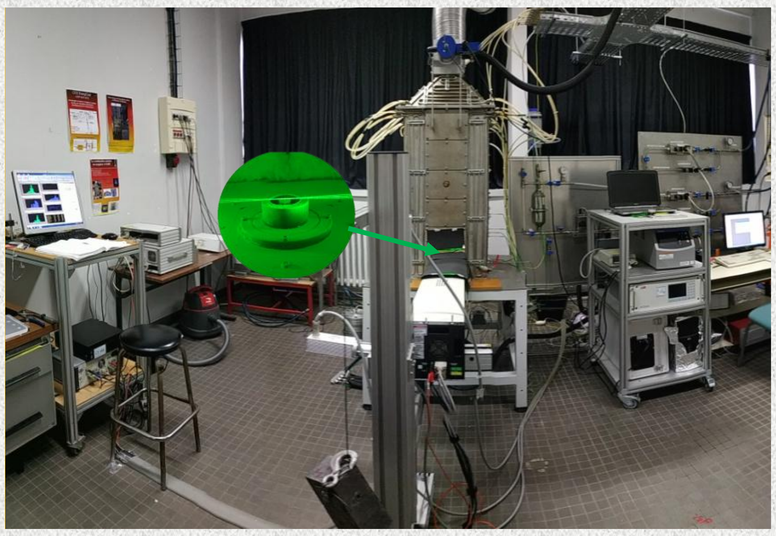
Flame lengths as a function of CO_2 and H_2O diluted for 25% oxygen enriched methane/air mixture for Sn=1.4 and ϕ=0.8.

→ EGR dilution increases lift-off heights about 60% compared to the case without dilution.

→ The flame becomes much taller with CO_2 dilution.



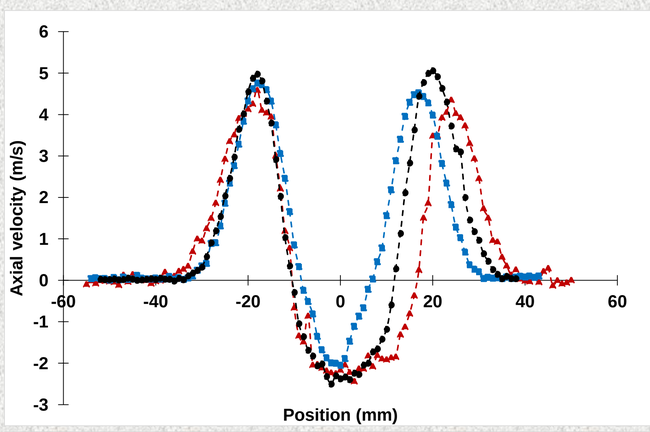
Laser Doppler Anemometry

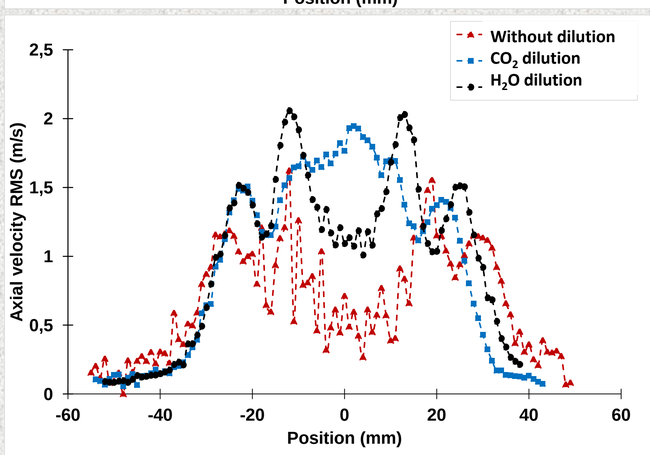


Axial velocity and RMS profiles at z=30mm with & without CO_2 and water vapor dilution for Sn=1.4 and ϕ=0.8.

→ With CO_2 and H_2O dilution, the maximum velocity is higher and the flow is narrower.

→ Root Mean Squares are higher in the case of dilution.





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