Chemical Burns : Understanding how they work in order to achieve an effective decontamination

The seriousness of a chemical burn

– **Depends on:**

- **the kind of chemical product and its concentration**
- **the length of the contact**
- **the size of the affected surface area**
- **the physical parameters (temperature, pressure)**

Which chemicals produce chemical burns?

- **Corrosives and irritants :**
  - **acids, bases, oxidizers, reducing agents, solvents**
  - **or in other words, about 25 000 chemicals**
- **It is important to note: a corrosive or an irritant can be toxic as well as noxious !**

What is Diphoterine?

- **A <u>aqueous solution</u> containing the base properties of water**

  = the effect of pulling the chemical aggressor away from the surface of the tissues

+ An <u>amphoteric solution</u>

  = acts on acids as well as bases, and rapidly restores the eye and/or skin's physiological pH

+ A <u>hypertonic solution</u>

  = stops the penetration of corrosive chemicals into the tissues creating a flux from the inside to the outside of the tissues

📂 **A medical device CE 0459, class IIa**

Diphoterine

- **Innocuousness and properties**
  - **non irritating to the eyes or skin**
  - **non toxic (DL_{50} acute oral, dermal > 2000 mg/kg)**
  - **non irritating rinsing residues (for acids and bases)**
  - **non sensitizing, non mutagenic (Ames test)**
  - **no side effects have been reported in workplace use**
  - **immediate decrease in pain**

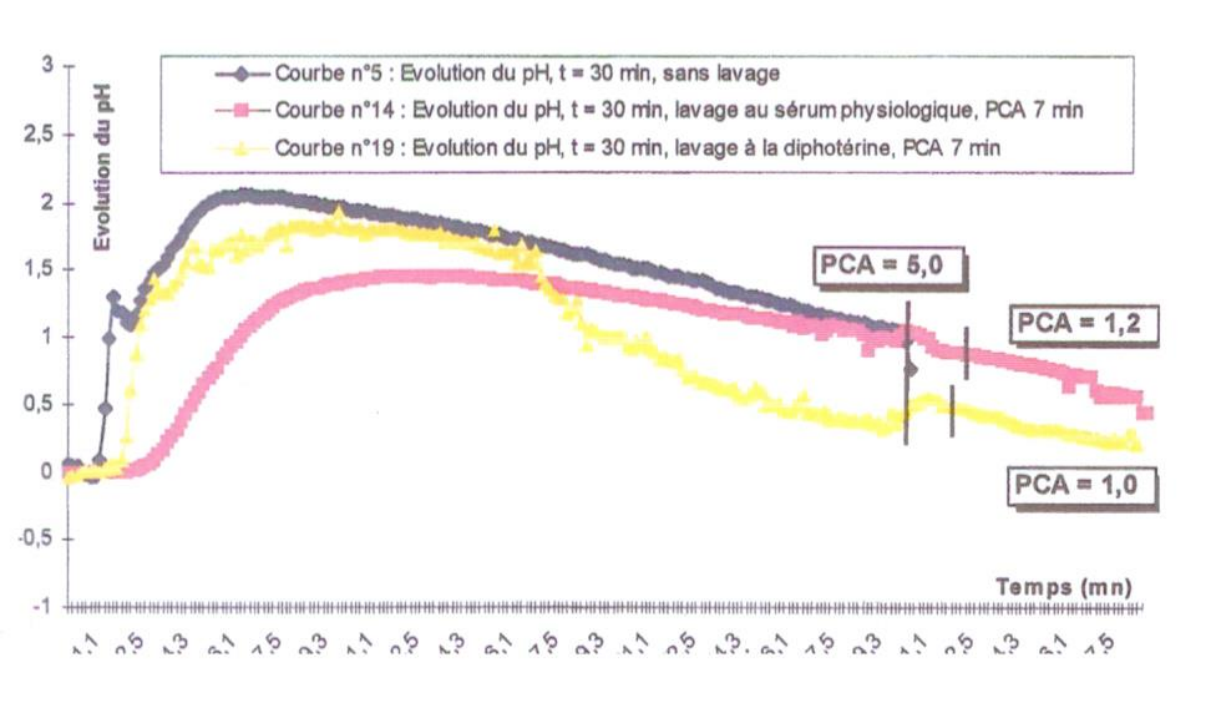
Skin study in rats
(concentrated HCl burn)
Diphoterine versus saline solution

- **Significant statistical results in favor of Diphoterine**
  - Decrease of inflammation
    - (IL-6 à 48h, $p < 0.01$; à 7 days, $p < 0.05$)
  - Decrease in pain
    - (substance P within 48h, $p < 0.05$; β-endorphin at 7 days, $p<0.05$)
  - Decrease in the size of the lesions
    - (no rinsing : 12mm; saline solution : 6 mm; Diphoterine 4 mm)
  - Improvement of the scarring

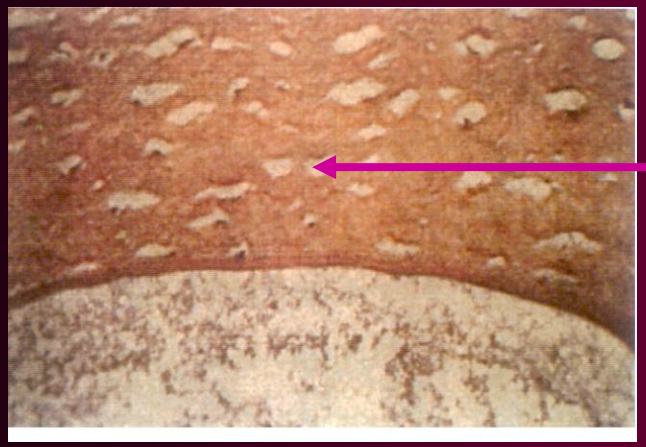
Ocular study in rabbits (concentrated ammonia burn)

Diphoterine versus saline solution

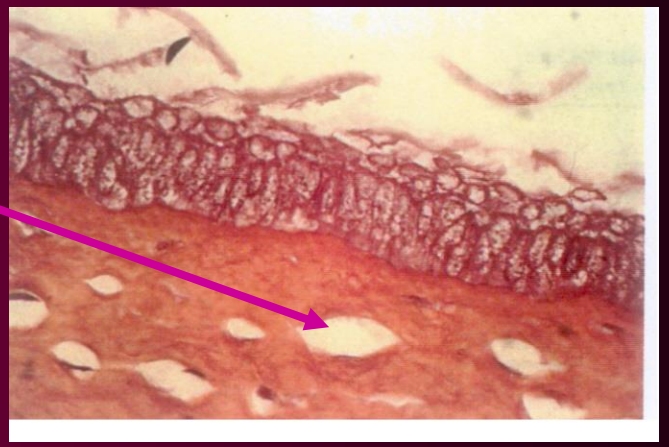
- Decrease in the inflammation, absence of oedema
- Decrease in pH



Ocular study in rabbits (concentrated ammonia burn)

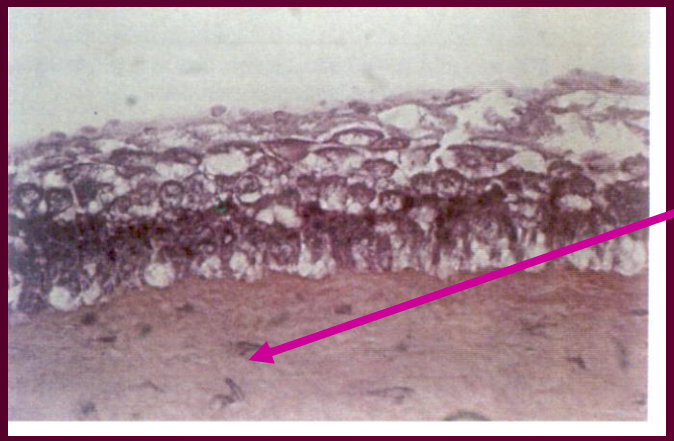


Stromal oedema



No rinsing

Saline solution



No stromal oedema

Diphoterine

Clinical results of 42 cases of chemical splashes

Martinswerk, Allemagne, 1991-1993

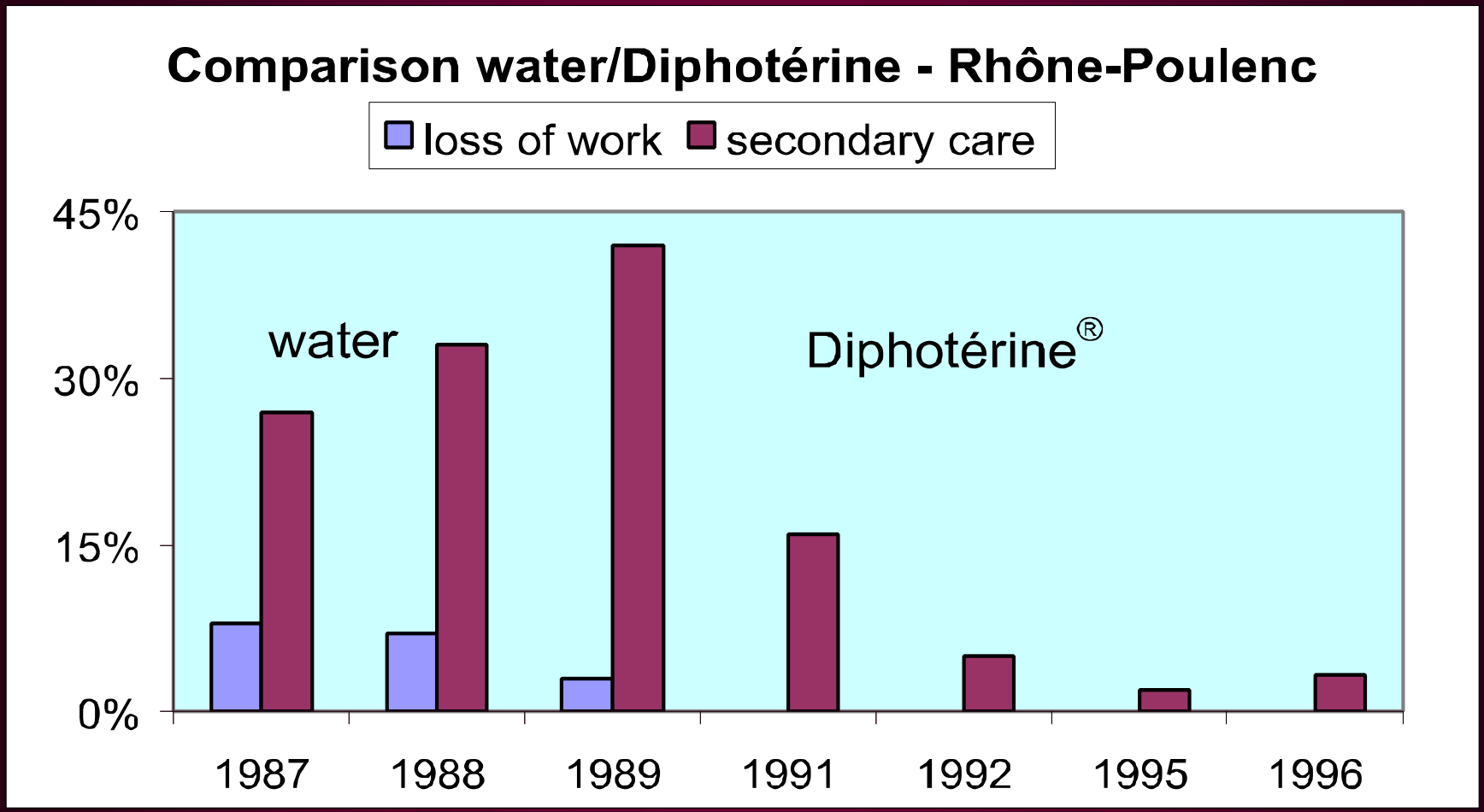
Rinsing	Diphoterine	acetic acid	water
Sick leave	0.18j ±0.4	2.91j ± 4.3	8j ± 8.12
No care	100% ±15	0% ±15	0% ±15
Basic care	% ±15	80% ±15	25% ± 15
Medical care	0% ± 15	20% ± 15	75% ± 15

Chemical in question : lye (40-600 g/l)

Protocol : On site rinsing

Results : Variability of the effectiveness of water rinsing , significant improvement with Diphoterine rinsing

Series of 175 cases of chemical splashes RHONE-POULENC, France, 1987-1996



Series of 24 cases of splashes
Manxman, Allergen, 1994-98

Splashes	Eye	Skin
Acids*	11	8
Bases**	4	1

* acids : sulfuric, nitric, phosphoric, sulfamic (5-100%)

** bases : calciumoxide, lye 30-45%, basic solution 30%

Protocol : Diphoterine on site + infirmary

Results : No after effects, no secondary care, no sick leave

Study of 375 cases at ATOFINA, France, 2000

Rinsing	water	Diphoterine
Sick leave	7(3.4%)	0(0%) (p < 0.05)
Without sick leave	198	170
Without follow-up*	68(52%)	88(33%) (p<0.05)
With follow-up	137	82

*The criterion without follow-up corresponds to no care

Chemical : Acrylates, sulfuric acid (98%), Oleum, lye (22%), Diethylaminoacrylate (ADAME)

Results : Significant difference in sick leave, as well as in the necessity of secondary care

Clinical study in Martinique
Comparison saline solution / Diphoterine
Delayed ocular rinsing

- Teams : fire-fighters, Emergency Medical Assistance Service (SAMU), Accident and Emergency, Ophthalmology

- Number of patients : 66 during 4 years (before/after study)

48 eyes (46%) saline solution / 56(54%) Diphoterine

- Protocol : rinsing with saline solution or Diphoterine

then the same treatment according to the stage of the burn

- Chemicals : bases (48% with Alkali-ammonia 15.3%)

- Nature of the splash : attack

- victim : male (2 patients out of 3)

Clinical study in Martinique
Comparison saline solution / Diphoterine
Delayed ocular rinsing

Length of time (days) reepithelialisation	Saline solution	Diphoterine	*p*
stage 1	11.1±1.4	1.9 ±1	10-7
stage 2	10 ±9.2	5.6 ±4.9	0.02
stage 3	45.2 ±23	20 ±14.1	0.21 NS

Results : significant difference for stages 1 and 2, tendency for stage 3, no stage 4 in the group Diphoterine

Conclusion

Rinsing with Diphoterine can be carried out following two protocols :

- either as first aid in the workplace, with the objective of preventing or minimising the appearance of chemical burns.
- or in the case of hospital treatment, to stop the progression of chemical burns, which allows a rapid return to a physiological state, and permits a secondary treatment adapted to the seriousness of the burn.