

KOCAELİ SANAYİ ODASI

**PROSES**  
EMNİYETİ SEMPOZYUMU

TOZ ÜRÜN PROSESLERİ İÇİN  
PATLAMA GÜVENLİĞİ

Onur AKGÜN

09-10 NİSAN 2019



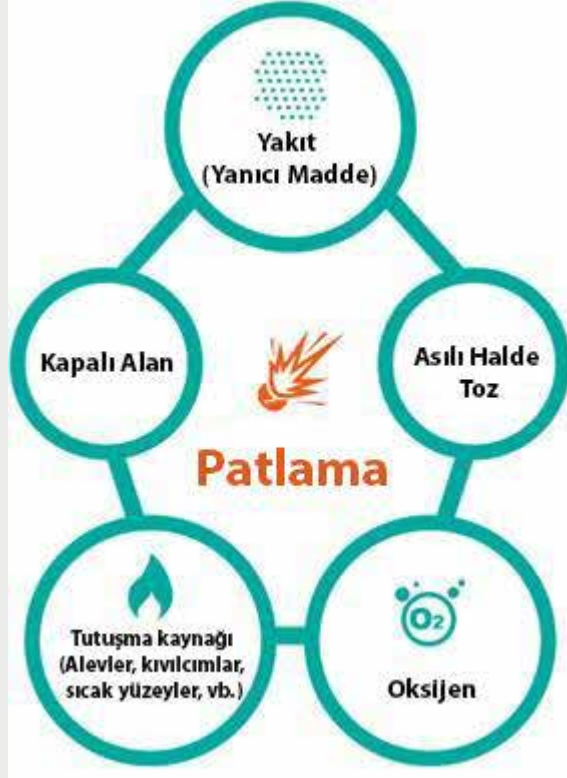
# Toz Patlaması Testi



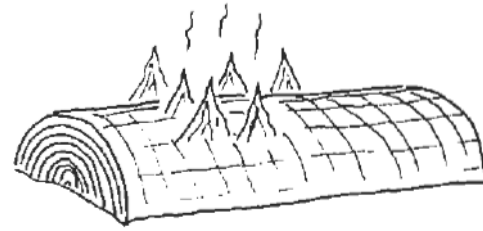
# Toz Patlaması Testi



# Toz Patlaması Oluşması İçin Hangi Şartlar Gereklidir?



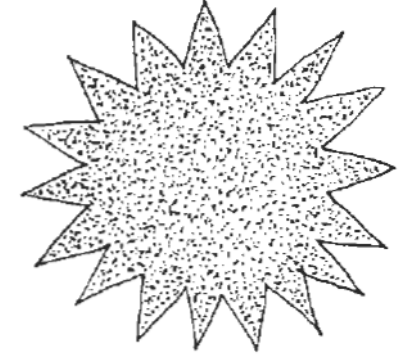
- Yanıcı toz
- **Kapalı alan**
- Tutuşma kaynağı
- Oksijen
- **Asılı halde toz parçacıkları**



(a) SLOW COMBUSTION



(b) FAST COMBUSTION



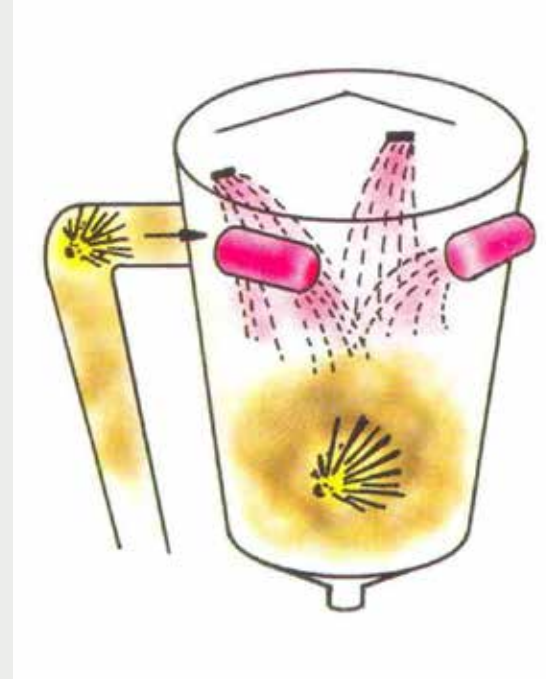
(c) EXPLOSION

## Hangi Tozlar Patlayıcıdır ?

Hangi malzemeler toz patlamasına sebep olurlar?

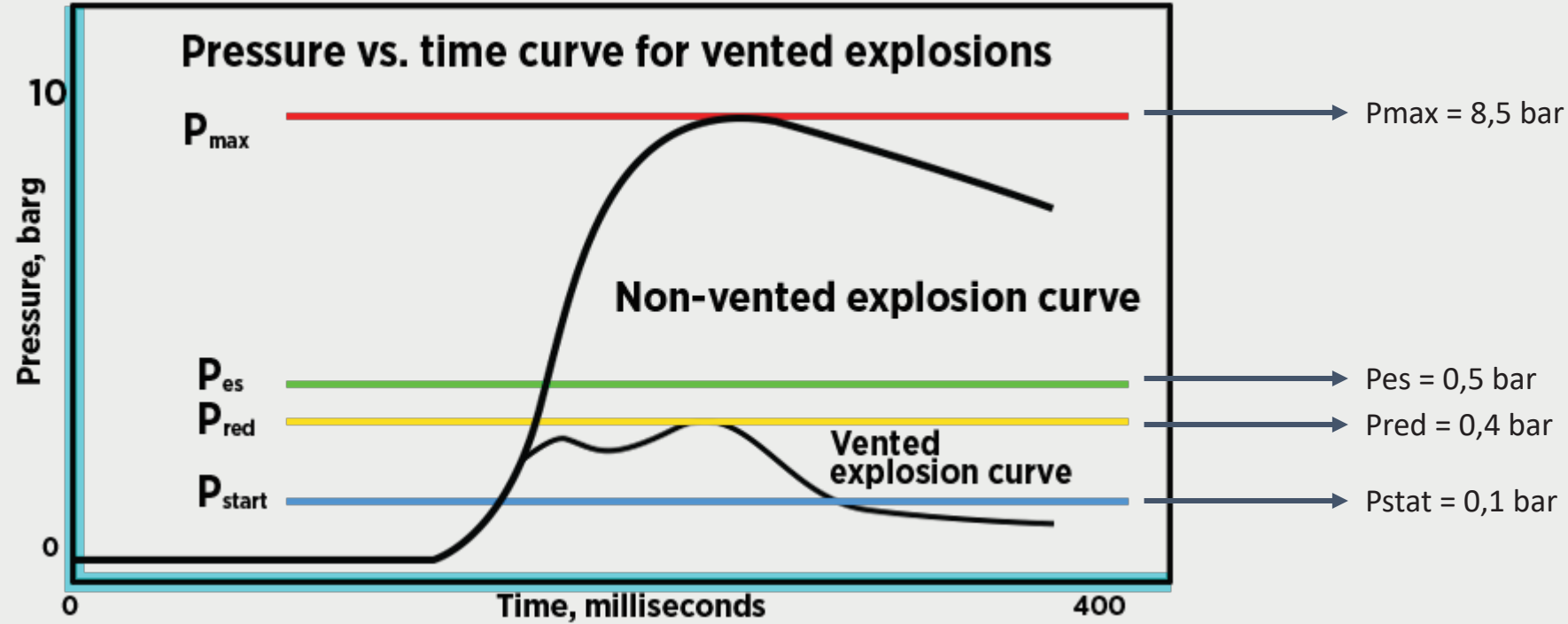
- Doğal organik malzemeler (tahıllar, nişasta, şeker, vb.)
- Sentetik organik malzemeler (plastikler, organik pigmentler, pestisitler, vb.)
- Kömür ve turba
- Metaller (alüminyum, magnezyum, çinko, demir, vb.)







Dizayn dayanım basıncı 0,5 bar olan mısır nişastası silosu nasıl korunmalıdır?







Safety is for life.

## TOZ PATLAMASI TAHLIYESİ

REMBE® Q-Rohr® ile ve onsuz





Explosion Safety of a trough chain conveyor using the Q-Box in a biomass power plant.



Explosion venting of a chip bunker using the Q-Box to protect the surrounding infrastructure.



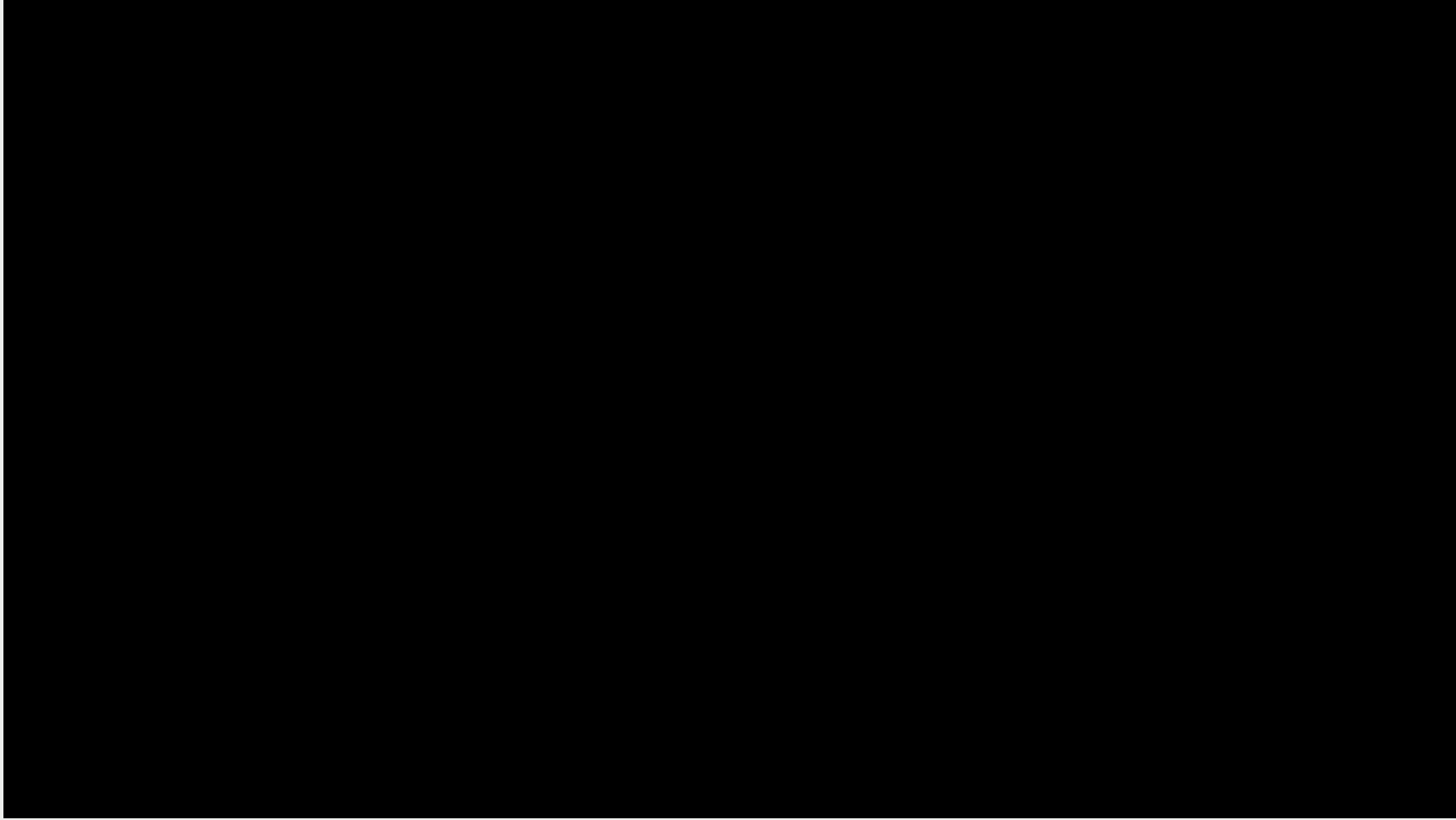


Toz Patlaması Tahliyesi  
REMBE® Q-Rohr® olmadan



# Patlama İzolasyonu





## Tipik Tesis Ekipmanlarında Patlama Riski

Ekipman	Patlama olasılığı	Patlamanın etkisi	Risk
Zincirli konveyör	Çok düşük	Orta	Küçük
Vidalı konveyör	Düşük	Orta	Küçük
<b>Kovalı elevatör</b>	Yüksek	Büyük	<b>Çok büyük</b>
<b>Silo ve bunker</b>	Düşük	Çok büyük	<b>Büyük</b>
<b>Filtre</b>	Yüksek	Büyük	<b>Çok büyük</b>
Elek	Düşük	Orta	Küçük
<b>Değirmen</b>	Yüksek	Büyük	<b>Çok büyük</b>

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# Tipik Toz Toplama Filtresi Koruması



## Bina Dışı Toz Toplama Filtreleri





## Açılı Patlama Kapakları Videosu



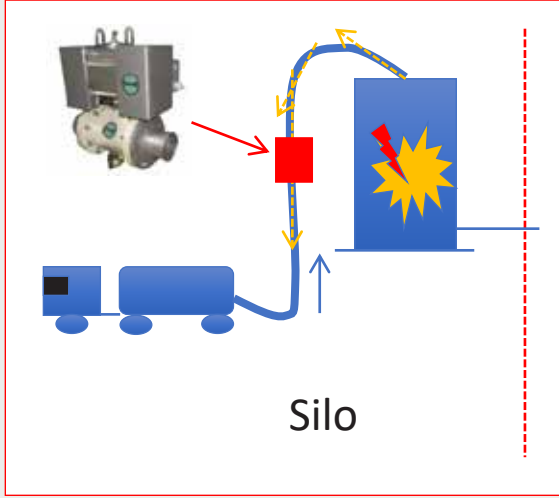
## Silo Toz Patlaması



# Tipik Silo Koruması



# Tipik Silo Koruması



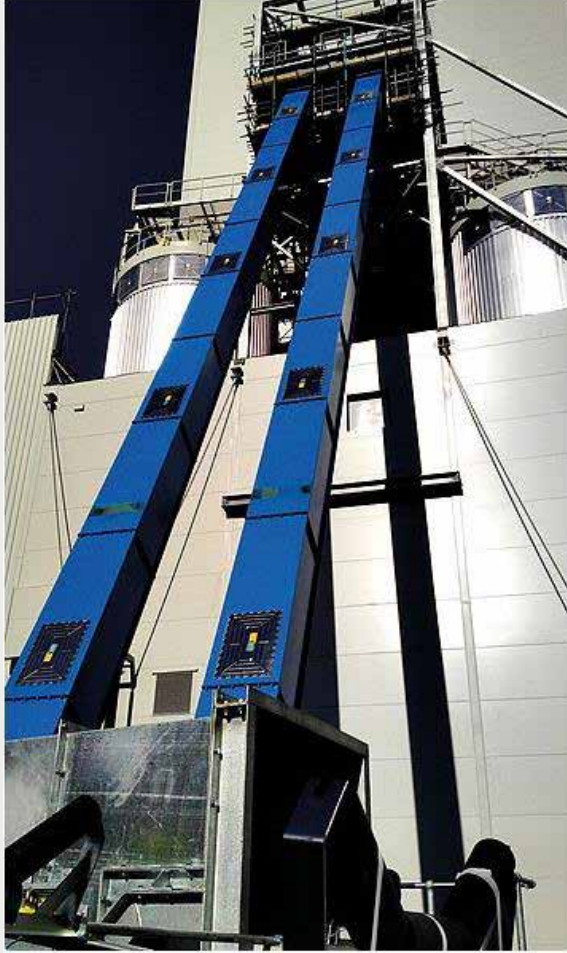
# Tipik Elevatör Koruması



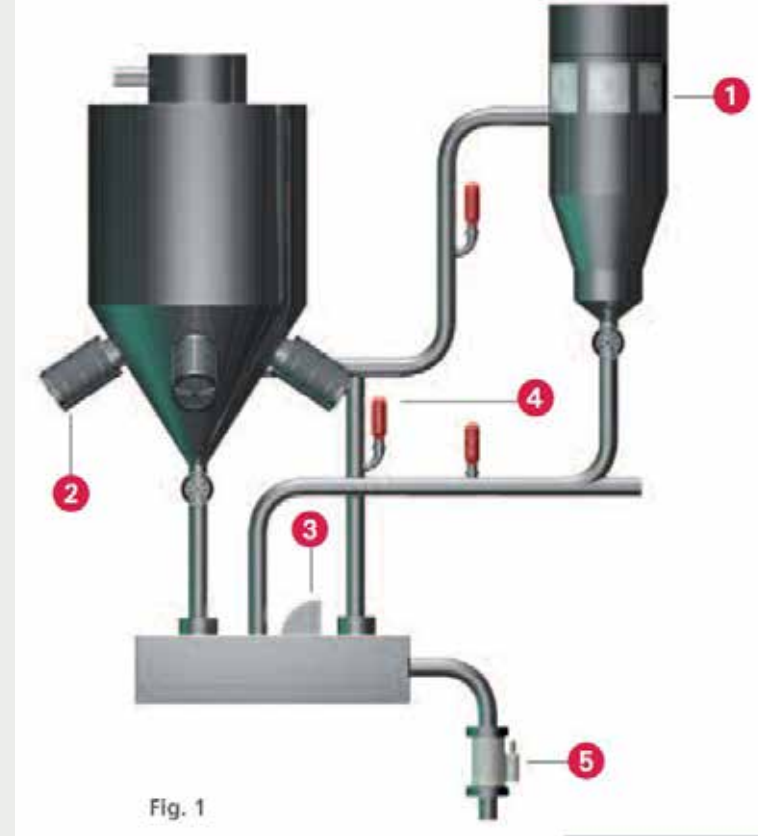
## Gerçek Bir Elevatör Patlama Testi



## Bina ii ve bina dıŐı elevat3r koruma 3rnekleri



# Tipik Spray Kurutucu Koruması





# Patlama Tahliye Alanı Hesaplamaları

EXPLOSION PROTECTION WORKSHEET

**REMBE® GmbH Safety+Control**  
Gellengang 11 | 41413 Arbon, Germany | T +49 (0) 1843 1486-0 | F +49 (0) 1843 1486-10 | info@rembe.de | www.rembe.de

Company

Address

Project

Contact

Phone

Fax

Email

### Cylindrical bin side protected

Process	
Maximum positive pressure	<input type="text"/>
Maximum vacuum	<input type="text"/>
Maximum process temperature	<input type="text"/>
Ambient temperature	<input type="text"/>

Combustible material	
Name	<input type="text"/>
P <sub>max</sub>	bar
K <sub>st</sub>	bar·m/s
MIE	mJ
Hybrid Mixture	<input type="checkbox"/> Yes <input type="checkbox"/> No
NFPA = < 10% LEC	<input type="checkbox"/> Yes <input type="checkbox"/> No
VDI = < 20% LEC	<input type="checkbox"/> Yes <input type="checkbox"/> No
Metallic dust	<input type="checkbox"/> Yes <input type="checkbox"/> No

Enclosure	
Tag/ID Number	<input type="text"/>
Manufacturer	<input type="text"/>
P <sub>red</sub> - enclosure strength	<input type="text"/>
Enclosure location	<input type="checkbox"/> Indoors <input type="checkbox"/> Outdoors
If indoors - distance to exterior	
a Body diameter	<input type="text"/>
b Body height	<input type="text"/>
c Hopper height	<input type="text"/>
d Vent to top	<input type="text"/>
Hopper bottom depth	<input type="text"/>
Hopper bottom width	<input type="text"/>

Filling and Discharging	
Inlet depth	<input type="text"/>
Inlet width	<input type="text"/>
Inlet pipe length	<input type="text"/>
Inlet type:	
Free fall filling	<input type="checkbox"/> Amount of product discharged <input type="text"/> kg/h
Pneumatic	<input type="checkbox"/> Conveying speed <input type="text"/> m/s
Batch	<input type="checkbox"/> Air flow <input type="text"/> m³/h
Pneumatic	<input type="checkbox"/> Conveying speed <input type="text"/> m/s
Tapered	<input type="checkbox"/> Air flow <input type="text"/> m³/h
Outlet Rotary Valve (Explosion proof)	<input type="checkbox"/> Yes <input type="checkbox"/> No

Comments:

GWG-ONE-1013R\_2

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### Rectangular bag house side protected (2)

Process	
Maximum positive pressure	<input type="text"/>
Maximum vacuum	<input type="text"/>
Maximum process temperature	<input type="text"/>
Ambient temperature	<input type="text"/>

Combustible material	
Name	<input type="text"/>
P <sub>max</sub>	bar
K <sub>st</sub>	bar·m/s
MIE	mJ
Hybrid Mixture	<input type="checkbox"/> Yes <input type="checkbox"/> No
NFPA = < 10% LEC	<input type="checkbox"/> Yes <input type="checkbox"/> No
VDI = < 20% LEC	<input type="checkbox"/> Yes <input type="checkbox"/> No
Metallic dust	<input type="checkbox"/> Yes <input type="checkbox"/> No

Enclosure	
Tag/ID Number	<input type="text"/>
Manufacturer	<input type="text"/>
P <sub>red</sub> - enclosure strength	<input type="text"/>
Enclosure location	<input type="checkbox"/> Indoors <input type="checkbox"/> Outdoors
If indoors - distance to exterior	
a Body depth	<input type="text"/>
b Body width	<input type="text"/>
c Body height	<input type="text"/>
d Hopper height	<input type="text"/>
e Hopper air height	<input type="text"/>
f Vent to top	<input type="text"/>
Hopper bottom depth	<input type="text"/>
Hopper bottom width	<input type="text"/>

Bags	
Bag diameter	<input type="text"/>
Bag length	<input type="text"/>
N° of bags	<input type="text"/>

Dirty air and clean air pipes	
Dirty air depth	<input type="text"/>
Dirty air width	<input type="text"/>
Dirty air pipe length	<input type="text"/>
Clean air depth	<input type="text"/>
Clean air width	<input type="text"/>
Clean air pipe length	<input type="text"/>

Outlet	
Outlet Rotary Valve (Explosion proof)	<input type="checkbox"/> Yes <input type="checkbox"/> No

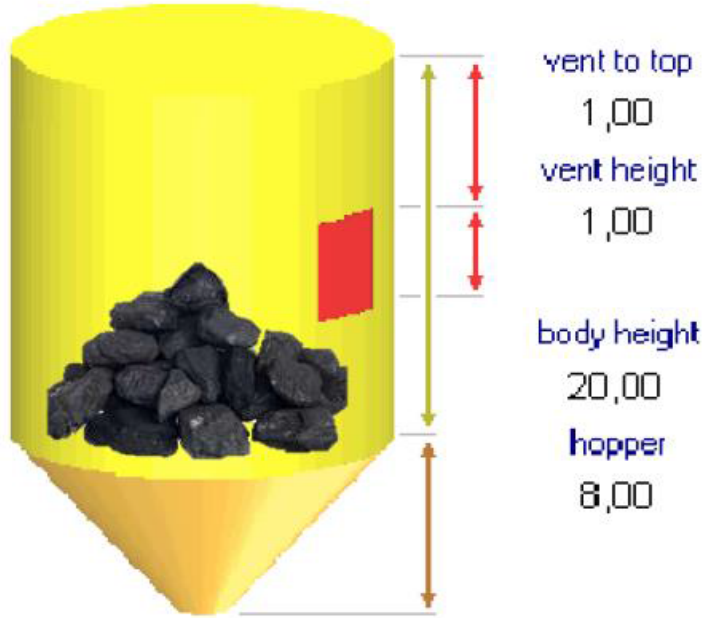
Comments:

GWG-ONE-1013R\_2



## Silo dimensions

body diameter: 10,00



bottom diameter: 0,500

[ m ]

Kömür tozu için;

Pmax: 8 bar

Kst: 100 bar.m/s

WinVent 3.1 e

Project Convert Report Handbook Help Exit

F3 Vessel Volume  $V = 1791.2$  m<sup>3</sup>  
Length / Diameter (eff)  $L/De = 2.26$   
Resistance (overpressure)  $P = 0.40$  bar R

F4 Standard

F5 Product data Explosion overpressure  $P_{max} = 8.0$  bar P  
Product-spec. constant  $K_{max} = 100$  m-bar/s K

F6 Rupture disk Activation overpressure  $P_{stat} = 0.10$  bar S  
Vent area (geometric)  $Ag = 23.22$  m<sup>2</sup> << A

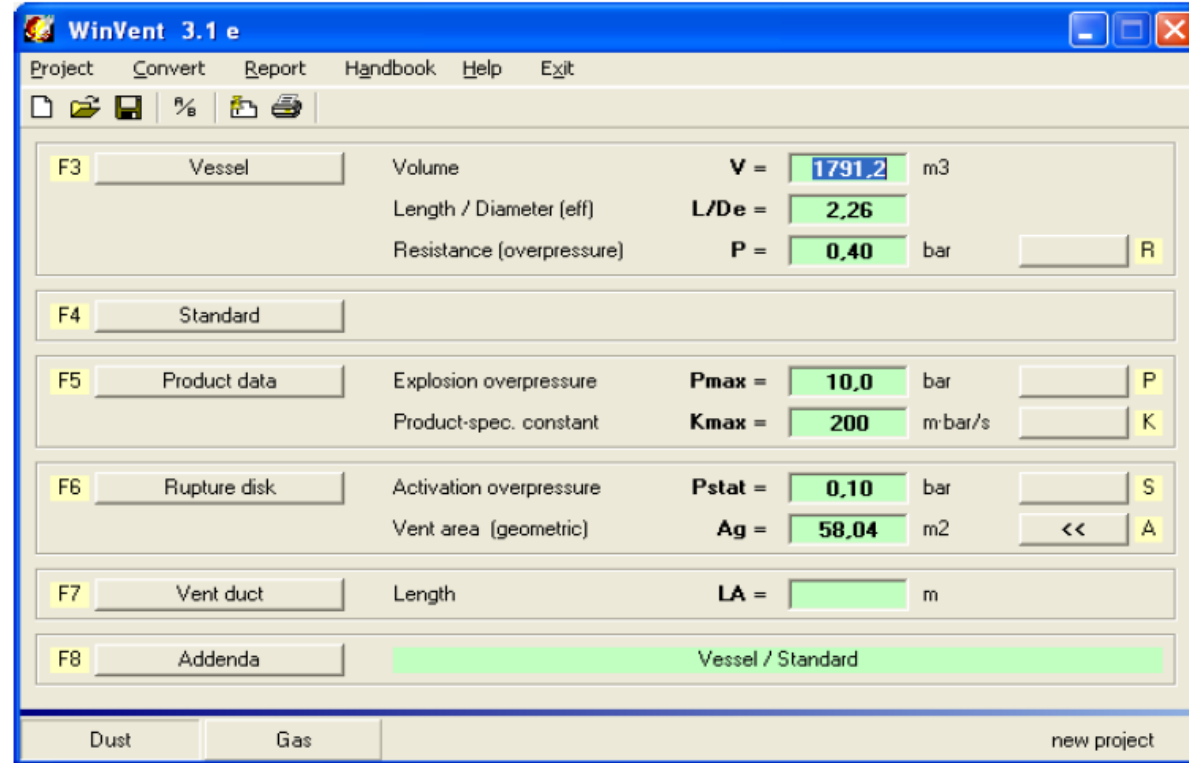
F7 Vent duct Length  $LA =$  m

F8 Addenda Vessel / Standard

Dust Gas new project



Kömür tozu için hesaplama yaptığımızda gerekli tahliye alanı yaklaşık 23 m<sup>2</sup> olmaktadır.



WinVent 3.1 e

Project Convert Report Handbook Help Exit

F3 Vessel

Volume  $V = 1791,2$  m<sup>3</sup>

Length / Diameter (eff)  $L/D_e = 2,26$

Resistance (overpressure)  $P = 0,40$  bar

F4 Standard

F5 Product data

Explosion overpressure  $P_{max} = 10,0$  bar

Product-spec. constant  $K_{max} = 200$  m·bar/s

F6 Rupture disk

Activation overpressure  $P_{stat} = 0,10$  bar

Vent area (geometric)  $A_g = 58,04$  m<sup>2</sup>

F7 Vent duct

Length  $LA =$  m

F8 Addenda

Vessel / Standard

Dust Gas new project



Aynı siloda ağaç tozu için hesaplama yaptığımızda gerekli tahliye alanı yaklaşık 58 m<sup>2</sup> olmaktadır.

# Kömür Silosu – Biyokütle Silosu

WinVent 3.1 e

Project Convert Report Handbook Help Exit

F3 Vessel Volume  $V = 1791.2$  m<sup>3</sup>  
Length / Diameter (eff)  $L/De = 2.26$   
Resistance (overpressure)  $P = 1.00$  bar << R

F4 Standard

F5 Product data Explosion overpressure  $P_{max} = 10.0$  bar P  
Product-spec. constant  $K_{max} = 200$  m-bar/s K

F6 Rupture disk Activation overpressure  $P_{stat} = 0.10$  bar S  
Vent area (geometric)  $A_g = 23.22$  m<sup>2</sup> A

F7 Vent duct Length  $LA =$  m

F8 Addenda Vessel / Standard

Dust Gas new project



Silo dayanım basıncını 0,4 bar'dan 1 bar'a yükselterek hesaplama yaptığımızda gerekli tahliye alanı yaklaşık 23 m<sup>2</sup> olmaktadır.



## TOZ Patlaması

Hakkımızda

Toz Patlaması

Patlamadan Korunma

Blog

Soru Cevap

Videolar

İletişim



**Tehlikenin Farkında mısınız ?**

