biotronic® Advance Develops

SCIENTIFIC BASES FOR RESEARCH

Treatment with Electromagnetic Dielectric Capacitive Monopolar Waves (OEDCM, by its Spanish initials)

Concept of OEDCM techniques

Advances in knowledge about dielectric behaviour of biological tissues have enabled the development of a new model of energy transmission through tissues, the Dielectric Capacitive transmission, mainly thanks to the contributions made by Gabriel et al. in their multiple research lines 97,114,115. The new transmission model allows an in-depth and selective energy application, that also comprises the transmission of different signals at the same time, widening in this way the therapeutical intervention possibilities 5,97,114,115.

Electromagnetic Dielectric Capacitive Monopolar Waves (OEDCM) are electromagnetic signals among 600 and 930kHz, transmitted in pulsed and modulated way in ever-changing frequency ranges in order to avoid accommodation of receptors 93,116,117. Signal pulse and modulation is controlled in a digital way in order to increase emission precision 118. Application is made in a Monopolar way in order to avoid enery transits through non-target tissues117,118.

This system represents a step forward in relation to Resistive application by means of electrical conduction119, what allows to make in-depth focused energy deposits without disrupting overlying tissues114,115,120,121.

Transmission types of electromagnetic signals

Electromagnetic energy transmission in tissues, through direct radiation on skin, may be achieved by two mechanisms: Resistive or by Conduction transmission and Capacitive or Dielectric Capacitive transmission 5,87,97,114.

Resistive transmission or transmission by Conduction is one that is carried out by conduction through a conductor element (metallic coated or uncoated) in contact with skin 87. In this type of transmission, energy transit through tissue may produce an increase of temperature according to Joule's law 87, thereby generating a heat directly proportional to tissue electrical resistance, that is, tissues with greater electrical resistance warm to a greater extent 96.

On the other hand, Dielectric Capacitive transmission is one that is produced when forming a series circuit of capacitors (elements with electromagnetic charge and discharge capacity, which acts as a temporary storage) (image 9) and when applying electromagnetic energy on the first of them 5. Energy is fully and efficiently transmitted by means of the discharge of a capacitor on the following one, releasing the last of them the same energy initially applied 5,114,115.

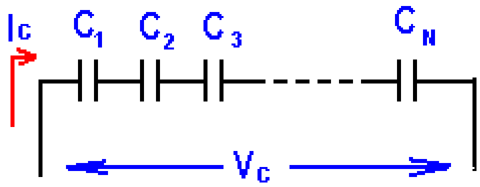


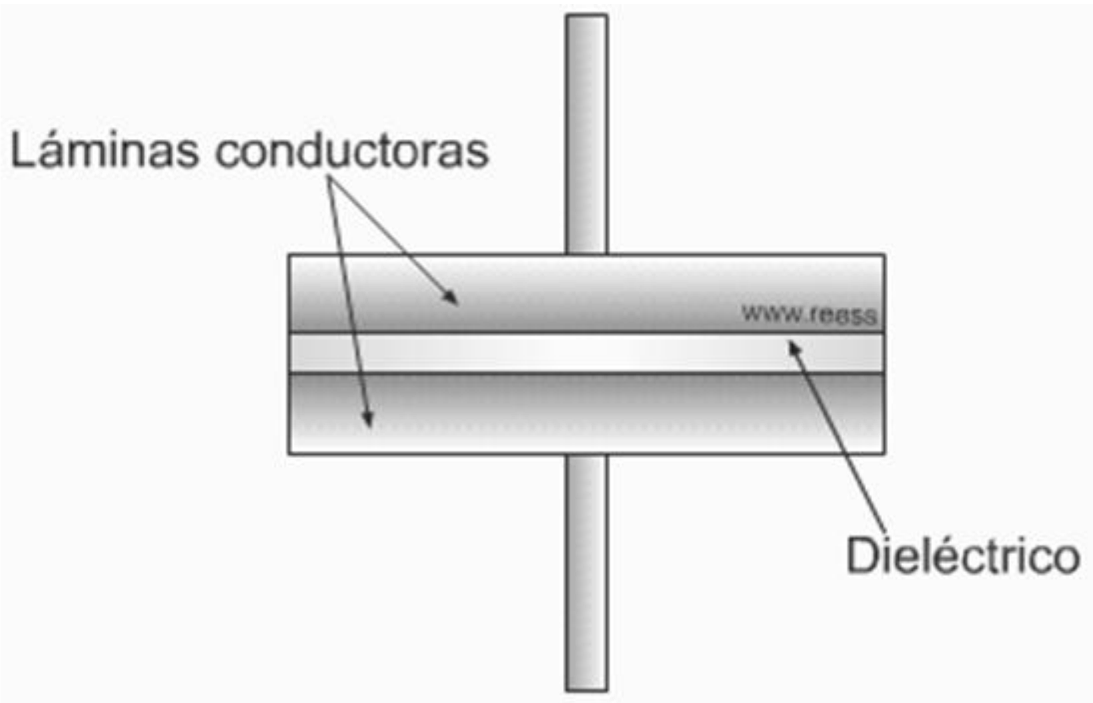
Image 9. Scheme of Electrical capacitors series circuit, taken from Ríos, S. Annex of Electromagnetic transmission types, 2nd edition, 2013. C= capacitor, I=intensity.

The development of Dielectric plastic polymers (image 10) allows the application of this transmission type on biological tissue, which behaves as a capacitor 93,116,117,122,123.

Image 10. Dielectric polymer coating of a Dielectric Capacitive transmission applicator.

In this type of transmission, the emitted electromagnetic energy comes to a metallic radiator of the application electrode, which behaves as one of the layers of a capacitor (image 11). The applicator enclosure acts as a dielectric (non-conductive material that allows the weight of the electromagnetic charge), enabling total energy transfer, forming in this way a perfect capacitor 5. A pure herbal oily substance must be applied between skin and the applicator in order to act as a dielectric; biological tissue is the other capacitor layer 118.

conductive layers



Dielectric

Image 11. Electrical capacitor scheme, taken from Ríos, S. Annex of Electromagnetic transmission types, 2nd edition, 2013.

In this way, it is achieved a transmission type that unlike the Resistive transmission does not need physical contact of the transmitter plate with the tissue, avoiding in this way electrolitic effects on skin surface and burnings due to Joule´s effect 87. This transmission constitutes a step forward in relation to conventional Capacitive transmission without dielectrics 87.

Through Dielectric Capacitive transmission are obtained several advantages. On the one hand, an equal action is produced both in tissues with a great number of bipolar molecules (blood, lymph, muscle...) and in areas with greater resistance to the passage of electromagnetic current (adipose tissue, bone, skin...)114, in contrast to what occurs in Resistive transmission, where each tissue conductivity will change the transmission, according to Joule´s law. In relation to waves transfer, the ones with hectometric length produce better resonances and piezolectric effects than shorter waves, avoiding at the same time cavitation phenomena 115. This greater transfer efficiency has an impact on in-depth biological effects in case of low powers, as it is a very efficient transmission mechanism 5.

Moreover, it is avoided a possible wave refraction and it is ensured the absence of radiolectric interferences thanks to the full energy transmission, so the therapist is protected against spurious radiation 115.

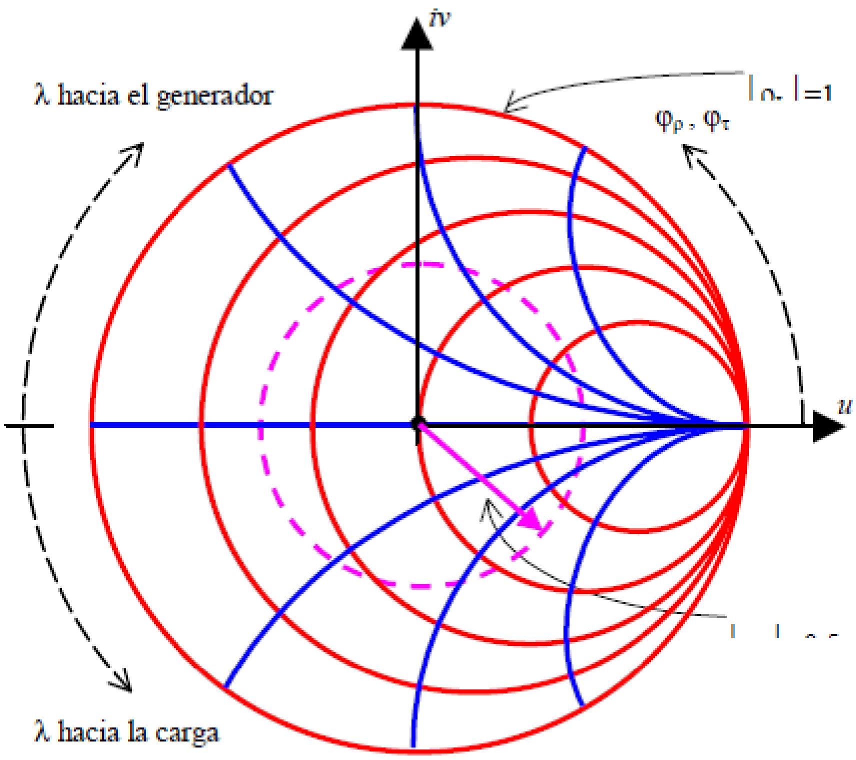
Application modality of OEDCM

There are two application modalities: Bipolar and Monopolar. Bipolar application modality (through two poles) is based on one emitter pole and other receiver pole, amongst which biological tissue is placed, closing the transmission circuit 87. This results in straight transits of energy conduction. Energy passes through all tissues interposed among the poles, which sometimes produces undesired effects on tissues that are not the target ones87. There is a slight variation in which two conductors reach the applicator, contacting one of them with the emitter and the other one with the receiver (being both of them in the same applicator). Electromagnetic waves will direct from the emitter pole to the receiver one, without passing through biological tissue, and so they do not confer an application advantage 87,124.

The Monopolar application modality is characterised in that only one conductor arrives at the applicator and no receiver pole is needed since it is based on the same system than radio antennas, with the biological tissue itself being the energy receiver 96,118.

This modality allows to locate in-depth energy deposits and to control the dosimetry (image 12) since the energetic discharge is produced from the whole surface of the patient to the ground plane, avoiding straight transits 120.

towards the generator



towards the charge

Image 12. Scheme of Smith chart for charges transfer according to impedance and admittance for Monopolar Dielectric Capacitive transmission 97, taken from Fernández, JC. Physics Department of the Enginnering Faculty from Buenos Aires, 2004.

Dielectric Capacitive transmission of electromagnetic signals opens unattainable levels of intervention with classic physical means, since it allows a precise energy dosing

in the site of action, situating the energy bioavailability within the therapeutic margin necessary to induce the desired physiological effects for each application.

Physiological effects of prescription for horse's shoulder treatment with the OEDCM technique of the DCD Animal Health® device

Techniques with electromagnetic signals digitally modulated, transmitted in a Monopolar Dielectric Capacitive way and carrier of low frequency waves (OEDCM), produce diverse physiological well-evidenced effects.

In horse's shoulder treatment the achieved physiological effects for therapeutic purposes are:

1-Vasodilation and controlled increase of local temperature, as well as local blood flow, which allows the withdrawal of algogen substances and the decrease of nociceptors activation 23,90–92,96,124–136.

2-Reduced inflammation that compresses nerve endings, thanks to the high frequency carrier signals modulated from 150 Hz to 200Hz; pulsed emission and athermal work cycle of 45%, that act on the cell membrane permeability, easing the drainage of the inflammation and the oedema142–148.

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